FREQUENCY OF QUANTITATIVE DECISION SUPPORT TECHNIQUES USED BY AIR FORCE SYSTEM ACQUISITION MANAGERS

THESIS

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THESIS

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Mark J. Donahue

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Abstract

The main focus of this thesis was to determine if exposing an Air Force system acquisition midlevel program manager to a computer aided quantitative decision support technique in an academic environment, effected the frequency that the manager used quantitative decision support techniques in actual program and project problems.

A quantitative decision support technique, decision tree analysis, was taught in the Intermediate Program Management (SYS-400) Professional Continuing Education (PCE) course at Wright-Patterson AFB, OH. Before this research began, the classes were doing the decision tree calculations without the aid of a computer. This study focused on whether modifying the curriculum to teach the use of PC based decision support system (DSS) decision tree computations to program managers would affect the frequency they used quantitative techniques in addressing actual program and project problems. The experiment was a posttest-only quasi-experiment design with nonequivalent groups. This study did not try to discover if other teaching techniques or other situations will alter the frequency of quantitative technique use.

Three months after course completion, a after-course survey was sent to each course graduate. The survey

measured the graduate's familiarity and frequency of using several quantitative decision support techniques to measure the effect of the classroom instruction. Demographic and responsibility were collected. This information was used to identify possible effects, other than the treatment effect, obscuring the analysis.

This study measured an increase (in the treatment group) in some of the technique familiarity, use, computerization benefit, computer program availability and use opportunity. The majority of program managers are familiar with several quantitative decision support techniques. However, very few managers use those techniques regularly.

FREQUENCY OF QUANTITATIVE DECISION SUPPORT TECHNIQUES USED BY AIR FORCE SYSTEM ACQUISITION MANAGERS

I. Introduction

General Issue

In today's highly complex and volatile environment, the program manager for Department of Defense (DoD) weapon system acquisitions must be able to make intelligent decisions that will effect the United States' national interests (24:165). A program manager must be able to coordinate and integrate the actions and resources of several different organizations as well as their own system program office (SPO) (14:46). The program manager must decide how to minimize the conflicting goals of the project's performance, schedule and cost criteria. Also, pressure is exerted for the project to meet supportability and reliability goals and various other criteria. There are constant demands for program manager's time and decisions.

Program managers are constantly evaluating different trade-offs that effect the system under development. They frequently ask such questions as "which choice is better for the entire life of the system?", "which trade-off will bring better performance?" or "what effect do these choices have on the current schedule and cost projections?". However, decision analysis assistance in answering these questions is not always readily available to the managers (20:151).

Management Science provides several quantitative decision support technique tools to the program managers to aid their decision making. The availability of personal computers (PC) and decision support systems (DSS) make the information gained from these techniques immediately available to the manager. There are numerous advantages for using a PC in a program manager's office (30:33) Through the use of PC-based decision support techniques, managers gain immediate feedback to questions and "What If?" scenarios. Just as a hammer cannot drive a nail without the carpenter, microcomputers can help managers do their work (5:2), but are rarely used by the managers (28:77).

DSS in support of battlefield commanders demonstrated the successful application of DSS tools (POST-PAWS, FLAPS, TERPES, etc.) (50:2-5 - 2-11). However, acquisition program managers lack similar support and tend to rely heavily on "back of the envelope" or "seat of the pants" decision making (6:1). This method of solving modern complex military problems is no longer effective nor sufficient (14:46-47).

Program managers gave three main reasons why they do not regularly use quantitative decision support techniques in helping them discover possible solutions to their problems (28:77, 40:38). First, they expressed reluctance to use quantitative techniques because of the effort involved in doing the calculations manually or having them done by a mainframe computer expert. The managers commented next on the difficulty in learning how to use the software. Third, they disliked the decision making process delay caused by the time spent explaining the situation to a computer expert and the wait for the necessary analysis information feedback (48:69-70).

Specific Problem

Does exposing an Air Force system acquisition midlevel manager to a specific computer-aided quantitative decision support technique, in an academic environment, increase the frequency the manager uses any decision support technique in actual program and project problems?

Research Objectives

A quantitative decision support technique, decision tree analysis, is taught to Air Force system acquisition program managers in the Intermediate Program Management (SYS-400) Professional Continuing Education (PCE) course at Wright-Patterson AFB OH. Before this research began, the classes were doing the decision tree calculations without the aid of a computer. This study focused on determining whether modifying the SYS-400 curriculum to teach the use of PC-based decision tree algorithms to program managers would increase the amount program managers used any quantitative technique in addressing actual program and project problems.

The following was used as a guide for this research:

1. How often do managers use quantitative decision support techniques, with or without the aid of a computer?

2. What tools do managers need to problem solve? What do they want to use for help?

3. Does a three month after-course survey of the treatment groups provide reliable results that can be compared to the three month after-course surveys of the control groups?

4. What demographic characteristics effect the frequency of quantitative decision support technique use?

5. The Defense System Management College has identified several decision support techniques, listed below, that are useful to program managers. How often do program managers use the following decision support techniques?

a. Life cycle cost analysis (13:17-8; 43:44-45)
b. Trade-off analysis (13:8-1; 43:19)
c. Statistical analysis
d. Linear programming (13:15-2)
e. Ranking
f. Risk and uncertainty analysis (13:15-1; 11:I-2; 43:19)
g. Cost driver sensitivity analysis (13:17-6; 43:41)
h. Reliability analysis (13:19-2)
i. Utility analysis (13:8-8)
j. Simulation (13:6-6)
k. Program network schedules (12:4-9; 43:18)
l. Schedule management (such as program status and identifying critical activities) (43:35)
m. Conducting schedule risk assessments (11:II-1; 43:37,45)
n. Estimating program milestones (13:9-1; 15:3-1; 12:3-1)
o. Decision tree analysis (11:IV-6)
p. Project Evaluation and Review Technique (PERT) and Critical Path Method (CPM) analyses (11:IV-2; 15:8-1; 12:4-1)
q. Developing alternate plans to meet objectives at the beginning of a program (43:40)
r. Cost/Schedule Control System Criteria (C/SCSC) (13:9-1)
s. Financial methods (43:42-44)

Scope of this Study

This study investigated how often Air Force system acquisition program managers use quantitative decision support techniques. Does teaching a PC-aided decision support technique (specifically, decision tree analysis) increase how often a program manager use any quantitative decision support technique? A research experiment was developed to investigate this question. The study was limited to Air Force midlevel program managers who attended the Intermediate Program Management PCE course at Wright-Patterson AFB OH., from October 1988 to March 1989. The variable studied was "How often managers use these techniques to aid solving program problems."

An after-course survey was used to gather information on the use of several different quantitative techniques to measure the effect of the treatment, classroom instruction. Demographic data was collected to determine if they effected the frequency of use. The demographic effects might disguise the treatment effects.

This study does not try to discover if other teaching techniques or other situations will alter the frequency of quantitative technique use. Determining and validating a set of demographic predictors for the program managers who are most receptive to using quantitative decision support techniques is left for future research.

Definitions

Management Science.

> A scientific approach to decision making, which seeks to determine how best to design and operate a system, usually under conditions requiring the allocation of scarce resources. (52:2)

System Program Office (SPO).

> The SPO is the basic organizational structure in Air Force Systems Command responsible for purchasing new weapons and support systems for the Air Force. If the SPO is responsible for only one system, it is called a single system SPO. If the SPO is responsible for more than one system, it is called a basket SPO. An example of a single system SPO is the B-1 SPO. An example of a basket SPO is the Airlift and Trainer SPO. (28:3)

Program/Project Manager. A project manager is responsible for all functions needed for a change to the organization (2:61). The change is the project and could be as diverse as the purchase of a new product line, the implementation of a new organizational structure, the design and/or implementation of a new organizational strategic plan, etc. (2:61-63). The difference between a program manager and a project manager is one of scale. A program manager is responsible for more than one project. This study uses the terms "program manager" and "project manager" to mean the same thing.

Decision Support System (DSS).

> A decision support system is a man-machine couple that facilitates incorporation of experience and instinct in decision making. Using electronic data recall, manipulation and graphic display to augment managerial judgement, decision-makers can review and edit their choices selectively before implementing an irrevocable decision. (23:24)

Summary

This chapter has provided the general background on the initiation of this thesis. There are numerous demands for the program manager's time and decisions. However, sophisticated decision support tools can both save the program manager's time and improve the decision process. Program managers have, in general, been reluctant to tap into this resource. The hypothesis is that if program and project managers are taught to use a computer to perform the difficult computations of a quantitative decision support technique, they are more likely to apply that technique, and possibly others, to actual problems that occur in their respective jobs.

Chapter II gives a more detailed background on the role of a project manager, characteristics of their work. It also describes how computers in the program office and quantitative decision support techniques can be beneficial within that environment. Initially, the roles of system acquisition program manager are discussed, focusing on two approaches to program management, problem solving patterns and types of decisional views. Next, the characteristics of the managers work and the system acquisition program managers environment are described. This is followed by an examination of program management aids, that is, how the manager can get more time to plan and analyze solutions to problems with computerized, standard output. An examination of how a decision support system must work within the managers' environment, problem solving patterns and decisional views to be beneficial is discussed. The chapter concludes with a description of the Management Science decision support tools that are available to system acquisition program managers.

Chapter III describes the methodology of the experiment and the statistical techniques used to collect information from the data. Chapter IV presents the information gathered from the experiment, while Chapter V details the conclusions of this research and some recommendations for future research.

II. Literature Review

Introduction

This chapter provides background for the ensuing research. Before investigating the question "Why do Air Force acquisition system program managers rarely use quantitative decision support techniques?", there must be an understanding of what such managers do and what type of environment they work in. How a manager solves program problems and how the computer can help the manager must also be understood.

Initially, the roles of system acquisition program manager are discussed, focusing on two approaches to program management, problem-solving patterns and types of decisional views. Next, the characteristics of the managers work and the system acquisition program managers environment are described. This is followed by an examination of program management aids, that is, how the manager can get more time to plan and analyze solutions to problems with computerized, standard output. An examination of how a decision support system must work within the managers' environment, problem solving patterns and decisional views to be beneficial is discussed. The chapter concludes with a description of the Management Science decision support tools that are available to system acquisition program managers.

System Acquisition Program Manager Roles

Mintzberg describes the three managerial roles as interpersonal, informational and decisional (34:58). The Project Management Institute, publisher of the periodical Program Manager, further describes the roles with a list of several project manager functions:

> planning and scheduling, performance analysis, progress reporting, maintaining client/consultant relations, project trend analysis, cost trends analysis, logistics management, cost control, organization and manpower planning, maintaining the technical/business interface, contract administration, controlling materials and manpower, estimating, and procedure writing and administration. (1:13)

The decisional role is separated into four sub-roles, the entrepreneur, the disturbance handler, the resource allocator and the negotiator (34:58). How should a systems acquisition program manager approach decision making in accomplishing these roles and functions? The next section examines this question.

Approaches to Program Management. Fox and Field describe two types of DoD project manager's views on decision making, the liaison manager view and the active manager view (20:302). They describe the liaison manager as needing little project manager experience and cost control experience and is therefore,

> limited to promoting the program, preparing progress reports, and performing technical liaison. The liaison type of manager relies on the contractor for cost control. (20:302)

The active manager view

> is based on the belief that the competitive forces of the market place do not produce the desired cost, schedule, and technical performance on large defense systems. (20:302)

The active manager must be actively involved in and familiar with all phases and processes of the project (20:303).

Fox and Field contend that, of the two views, the active manager is the preferred management approach. They "consider the defense acquisition process too complex, too costly, and too important to national security to serve as an alternate assignment" as a liaison manager would (20:304). The liaison manager is primarily concerned with the interpersonal and informational types of roles and functions. The active manager is equally concerned with all the managerial roles, including the decisional role.

There are constant demands on program managers for their time and for their decisions. Program managers must be able to coordinate and integrate the actions and resources of several different organizations as well as their own system program office (SPO) (14:46). Active managers must decide how to minimize the conflicts between the program's performance, schedule and cost. Pressure is exerted for the project to meet supportability, reliability and many various other goals.

In today's highly complex and volatile environment, the program manager for Department of Defense (DoD) weapon system acquisitions is faced with having to make intelligent decisions that will effect the United States' national interests (24:165). The national interests are important to the active manager when considering the alternatives in solving problems in the program office.

Problem Solving Patterns. How does the active manager solve problems in their programs? Problem solving is the primary function of managers (2:2-4; 45:32). The complexity and the difficulty of solving the problem is what motivates the manager to think about and develop alternative solutions (47:25). Stavenjord lists four approaches to applying that process. One of these four patterns are generally followed:

1. Crisis management: selecting the first solution that is presented.
2. Cookbook problem solving: using a "laundry list" to match the problem with a solution.
3. Reflective thinking: decision based on analysis of the situation.
4. "Habitually reflective thinking: automatic reflective thinking, always step back, look at issue, develop alternatives", and arrive at a decision that makes sense as the best solution (47:25-26).

The manager should try to solve problems by habitually reflective thinking. This takes planning, data and knowledge to transform that data into meaningful information. Any tool that is made available to managers must enable them to progress to constant, habitually reflective thinking. But what does a program manager use as the criteria to select between the alternatives discovered through habitually reflective thinking?

Decisional Views. There are several reasons a project manager chooses a specific solution. Keen and Morton suggest that there are five views of selecting a decision:

> 1. The economic rational concept: This is the classical normative theory of decision making, in which decision makers are all-knowing and able to evaluate all alternatives. They are dissatisfied with any solution but the best.
>
> 2. The satisficing, process-oriented view: This considers the decision makers to be intendedly rational although cognitive limits lead to a bounded rationality; thus the goal of any decision maker is to get a good enough answer, not the best possible one. This point of view stresses the process of decision making and not just its outputs; it emphasizes the relatively limited analysis and search most managers will make and their reliance on heuristics.
>
> 3. The organizational procedures view: This focuses on the interrelations among components of the organization. It highlights organizational structure, mechanisms for communication and coordination, and the standard operating procedures by which decision making is systemized and often simplified.
>
> 4. The political view: This regards the participants in the decision process as actors with parts to play. They have strong individual preferences and vested interests and form coalitions of organizational subgroups. Decisions are frequently dominated by bargaining and conflict, with the result that only small deviations from the status quo are normally possible. Major innovations are (quite reasonably) resisted by those who position, interests, or simply job satisfaction will be affected.
>
> 5. The individual differences approach: This view argues that an individual's personality and style strongly determine his or her choices and behavior. Personal 'rationality' is subjective and behavior is very much determined by the manner in which an individual processes information. (27:80)

Each of these viewpoints is a valid selection criteria in different problem solving situations. A decision support system might be informative for one viewpoint, but irrelevant for another.

Selection of a decisional view might be influenced by the managers' background, responsibility areas of decisions, personal approach to program management, the external pressures of the job, or various other factors. In what kind of environment do they perform their managerial roles? Do active managers have time for habitually reflective thinking? This is examined next.

Program Management Environment

A Massachusetts Institute of Technology researcher, working with the DoD, documented some difficulties of a DoD decision maker.

> The complexity of the battlefield imposes severe constraints on the human beings who participate in the operations. The decision-making and information processing organizations designed to execute these tasks exist in hostile environments where the tempo is fast and the data to be gathered and analyzed are numerous. Therefore, ..., the distribution of processing between the hardware and human components is a necessity in order to facilitate the task carried out by each organization member. Their activities are synergistic and coordination of the decision-making processes must be achieved in order to improve the effectiveness of the organization. It follows that structures which allow the coordination of the different activities necessary to fulfill the mission must be designed. However, decision aids also increase the possible alternatives among which to choose in order to process information, and in so doing, modify the nature of the decision-makers' activities. (22:19)

The hectic pace of a battlefield is similarly characterized in the activity in the program office. Just as battlefield commanders have numerous staff personnel providing them information, the SPO program manager has a staff to provide information. There are five different divisions in the SPO:

> 1. The program control ... division directs overall planning, programming, collection and analysis of cost and schedule data, performance reporting to higher levels in DoD, and financial management.
>
> 2. The configuration management division establishes and implements policies and procedures for configuration management: system equipment and facility identification specification, engineering change control, and performance reports on all such activities.
>
> 3. The procurement/contracting and production division manages all procurement and production activities and supervises the planning and execution of all contracts for research studies, engineering development, tests, and production.
>
> 4. The systems engineering division manages the total systems engineering function, including the integration of engineering systems and subsystems. This division is also responsible for the quality of the technical performance of the weapon system.
>
> 5. The product assurance (or test and deployment) division plans and coordinates the test programs for the weapons system. (20:157)

How managers use their time has been meticulously studied. Mintzberg conducted a study of five chief executives who were directly observed for five weeks (33:25,32) and described the managers' day as disjointed, characterized by numerous short activities and constant interruptions (33:25-26, 29:19). Each of the managers' activities averaged less than twenty minutes except scheduled meetings (33:33). "Half of the observed activities were completed in less than nine minutes, and only one-tenth took more than an hour" (33:33).

Managers structure the organization to provide the most current information as fast as possible. That is the reason for the constant interruptions and disjointed activities. The manager "demonstrates a strong thirst for current information and ... tends to do little with routine reports that his organization provides for him" (33:36). Luthans, the president of the Academy of Management, presented similar information in a report for the Academy of Management's (31:8).

<u>Work Characteristics</u>. Mintzberg determined thirteen characteristics of a manager at work. The manager:

1. is "compelled to perform a quantity of work.... Breaks are rare" (33:51).

2. is "characterized by brevity, variety and fragmentation" (33:51).

3. "prefers brevity and interruptions" (33:51).

4. "gravitates to the more active elements of his work" (33:51). Very current information is highly prizeds.

5. "favors the verbal media, spending most of his time in verbal contact" (33:51).

6. gives mail "cursory treatment", ... writes "much less mail than he receives" (33:52).

7. uses "telephone and unscheduled meetings ... for brief contacts ... and when information or requests must be transmitted quickly" (33:52).

8. schedules meetings that "consumes more ... time than any other medium" (33:52).

9. spends "little time ... in open-ended touring" (33:52).

10. has "external contacts [that] generally consume one-third to one-half of the manager's contact time" (33:52).

11. allows subordinates to "generally consume one-third to one-half of the manager's contact time" (33:53).

12. spends "relatively little of his time with his superior - generally on the order of ten percent" (33:53).

13. "is responsible for many initial commitments, which lock him into a set of ongoing activities" (33:53).

The program manager is constantly inundated with staff information and demands for decisions based on that information. The manager must balance the conflicting requirements of the program's schedule, cost, performance maintainability and numerous other criteria. Trade-offs and compromises are constantly evaluated. The program manager must accomplish all of this with a limited number of people and a limited amount of time.

Most of a manager's time is spent in short bursts of activity on numerous different activities. A manager cannot devote an extended period of time on any single problem or activity. It appears that managers would place significant value on "time savers" or "time multipliers", which allow them to accomplish several activities at the same time. How a manager can accomplish this is exemined next.

Program Management Aids

Two "time savers" available to the program managers are computerized standard output and computerized decision support techniques, decision support systems. Implemented effectively, these could provide the managers with time and information needs for habitually reflective thinking. This facilitates planning to minimize or prevent future program problems and developing alternative solutions to current problems. The benefits and disadvantages of each technique are explored next.

Standardized Output. There are numerous advantages for using a personal computer in a program manager's office (30:33). Just as a hammer is given to a carpenter to help accomplish a task, microcomputers have been provided to managers to help them do their work (5:2). John T. LeSueur, an Air Force system acquisition program manager, listed four major areas with an example for each: word processing (spell checking), electronic mail (information/ data exchange), spreadsheets (fast reaction to changes and showing various viewpoints) and program management tools (PERT/Gantt charts and tracking tasks to be accomplished) (30:33-34).

Another program manager, Michael F. Turner, listed several other benefits: reduction of manual tasks, decrease in the number and the length of interruptions, the availability of a centralized information storage area, the decrease in document turn around time, the speed of distributing documents and the ease of making revisions, retrieving information, automatic filing, scheduling meetings and delegation of duties (49:14).

Advantages. The literature noted there are two major benefits from using computers for standardized output in the program manager's office. First, the ability to generate similar reports quickly and accurately can save time for the manager (49:13). A faster learning process is the second advantage of computerizing standardized output. Specific guidelines are normally established for the format of reports (53:72; 9:43). The same margins, ratios, displays of information (tables and graphs), and the use of preprinted forms are difficult to learn initially and detract from the manager's more important job of managing. Computerized output speeds up the learning process for the new manager (53:73).

<u>Disadvantages</u>. There are two main disadvantages of using computers for standardized output in the program manager's office. It is difficult to implement any changes to the "old habits" and it is difficult to learn the new working procedures by using the new computer (49:13). Most of the planning time is spent on which computer system to acquire and how to install them. Little, if any, time is used to plan new work techniques, learning requirements, and the use of the new computer to aid project success (49:17). Initially, there may be a high error rate in report output or even an increase in report accomplishment time while the worker learns how to use the new computer (44:707).

Using a computer to do repetitive tasks allows more time for the manager to concentrate on problem solving. The disadvantages can be minimized with proper planning and integration with user needs and desires. Training before computer installation can decrease the disadvantages. Is the computer an aid in solving problems? The next "time saver's", computerized decision support systems, advantages and disadvantages are discussed next.

Problem Solving Tool. Only nine percent of the program managers stated they often used a quantitative decision support technique, statistical analysis (28:77). Why don't these managers use this tool? Is it because it wasn't computerized?

Tools used by the manager need to complement Keen and Morton's view of managerial of decision making: economic rational, satisficing, organizational procedures, political views and individual differences. A tool should fit into the managerial environment, support short activities and numerous interruptions, and provide current information. Mintzberg described a three step decision making process. First, identification; the recognition and diagnosis of the need for a decision. Second, development of solutions; the search and design of alternative solutions. Third is the selection, screening, evaluation and authorization of the selected solution (34:58). A decision support technique must support all steps of this process.

The active manager should obtain as much information from several problem perspectives before a crisis exists, which could lead to a more rational, informed decision and habitual reflective thinking. A tool to assist in achieving that level of thinking is the computerized DSS. The advantages and disadvantages of a computerized DSS are discussed next.

Advantages. A decision support tool available to the manager is the computerized decision support system (DSS) (23:24; 9:43). The DSS can guide the manager through several alternatives to specific problems or simulation of problems (9:43; 19:5; 23:24; 30:35;37:27). Being exposed to several options, the manager can develop better solutions to a problem than if the manager used crisis management or textbook solutions that do not entirely match the real problem parameters (47:25). These alternatives guide the manager to leaning different techniques for problem solving (25:1646). These benefits lead to habitually reflective thinking.

A decision support system can be used to track the implementation effectiveness of the decision. It provides information that helps the decision maker choose which variables of the problem are most important and should be monitored. The decision support system can help the manager's office "execute their project in a more effective and efficient manner" (9:43).

The "What if?" capability of a decision support system allows the manager to plan ahead for future problems and possibly prevent, or at least minimize, the effect of some problems (18:2, 23:24). Additionally, the display of alternative solutions to the same problem gives insights to the manager on considering different approaches from different decision making methods (18:3, 9:43; 19:10). This advantage facilitates planning and problem minimization before the problem develops into a crisis.

Computerized decision tools are desired by the majority of project managers (28:81-84). The computerized decision support system helps the project manager to react faster and more intelligently to the pressures from a superior's request for additional information and the constant program trade-offs required between cost, performance, and schedule of the project.

Computerized decision support systems aid the manager in making better decisions, but will not replace good judgement (9:43). They do not give the decision maker the "right answer"; only the decision maker can decide what is correct for their specific situation (18:3). Instead, decision support systems give the manager a rational set of alternatives and teach the manager different methods of problem solving (18:3, 9:43). They allow the manager to focus on the most significant problem and gives the manager the capability to test a solution (simulation) before the solution is irrevocably implemented (23:24; 47:25).

Decision support systems allow the manager to plan ahead for possible future problems by asking "What if?" type questions (23:26), and information to prevent a problem from occurring (9:43). Thirty to fifty percent of the SPO program managers' time is spent promoting and defending their programs to upper management (20:302). They must be able to justify their decisions with rational information.

The computer allows the manager to delegate to the office staff the information gathering, suggestion of alternatives and implementation of solutions (23:26). This delegation helps the manager to avoid being what General Skantze, former commander of USAF Systems Command, calls a "good news program manager" (46:20). The better informed the program manager is, the more successful the manager (46:20).

Disadvantages. There are numerous pitfalls in using a computerized decision support system. The problems faced by a specific program manager are unique (51:501). Program managers prefer to set specific boundaries and relationships for their individual project and think that the project will remain static (47:24). However, the manager's program is always changing. Writing a computer program that will solve some future problem in a program that is dynamic is difficult (53:72).

Various computer programs are written to solve some short term problem or are very narrowly delimited. This often causes program managers to increase the number of items they try to manage without gaining any real control of the problem that needs solving (4:36).

The manager may try to influence every minute detail, even if that detail does not contribute significantly to the accomplishment of program goals (4:36). Some decision support systems rearrange the data, but not in a very meaningful pattern (53:72). The manager may be creating information reports just for the reports sake and not for the information (4:36). This can lead to short term goal achievement that could be counterproductive to the long term goals of the program office (3:39).

The common user of computer programs, like a decision support system, is not a computer specialist (8:244), a significant point since some computer programs are difficult to learn and to use (25:1646, 53:73). This fact normally causes the computer programs to be only "expensive novelties" that sit on the shelf gathering dust (53:72). Some programs only accomplish part of the user's goals and leave the user frustrated (32:340). Some decision support system models are too simple or are designed to make the same decision mistakes the programmer/expert might make (9:43, 51:501, 53:73).

Incompatibility of computer hardware systems is another problem (9:43). The information may be unavailable to other computer systems or programs. More work might be needed to update several computer systems than if a manual system was used (41:29). The tasks assigned to subordinates of the manager may have to be redefined and the job may become boring and repetitious (21:356).

Program Management Aids Summary. In order for a computerized decision support system (DSS) to help the manager, it should complement the manager's decisional views. A DSS must fit into the manager's hectic schedule. It should provide very current information, take little time to use and provide uncertain, ad hoc, external information (33:195-196).

The goal of a decision support system is to take the necessary data and transform it into a form that is meaningful to the manager. The manager is sometimes overwhelmed with reams of printouts that are not useful and often confusing. If the form isn't informative, the decision support system will not be used.

Project managers have expressed a need for certain decision support techniques to be computerized (28:81-85). Computers should be used to assemble data, synthesize it into information and then correlate and distribute the information.

Some of the available Management Science decision support techniques are examined next.

Management Tools

The literature notes that the program manager has several good Management Science tools available to aid in the decision making process. The Defense Systems Management College (DSMC), a government college created explicitly to train program directors and managers, provides training in using these quantitative decision support techniques. The DSMC Systems Engineering Management Guide defines several of the tools. All of these tools have been computerized. However, The tools are still beneficial without a computer.

Life Cycle Cost (LCC) - the total cost to the government of acquisition, ownership and disposal of a system over its entire life (13:17-8). Life Cycle Cost Analysis is the structured study of LCC estimates and elements to identify life cycle cost drivers, total cost to the government, cost-risk items and cost-effective changes (13:17-8).

Trade-off Analysis - "Trade-off analysis methodology provides a structured, analytica' framework for [evaluating] a set of alternative concepts or designs" (13:8-1).

Risk Managemen. - Risk and uncertainty "management is an organized means of identifying and measuring risk and developing, selecting and managing options for handling these risks" (13:15-1).

Risk Analysis - "determines the probability of events and the consequences associated with their occurrence" (13:15-1). Also, risk analysis can "discover the cause, effects and magnitude of the risk perceived, and to develop and examine alternative options" (13:15-1). DSMC's "Risk Assessment Techniques" defines Risk Assessment as a

> mathematical analysis of the probability of achieving or not achieving acquisition program cost, schedule or performance goals (12:B-4).

PERT/CPM (Program Evaluation and Review Technique/ Critical Path Method) - Plan, schedule and control a projects time aspects and, with some modification, cost aspects (36:298).

> A graphical portrayal of the interrelationships among the elements of a project, and an arithmetic procedure which identifies the relative importance of each element in the over-all schedule. (36:4)

Decision Tree Analysis - "A graphical representation of a decision problem used to determine optimal choices" (52:587). This includes risk aversion, utility theory, and expected value of information theory (52:601-602).

Schedule Management - resolving conflicts between a program's schedule, cost and resources (13:2-3).

Reliability - "sustained operational performance over time" (16:1). The process of measuring reliability is well described in HQ AF's "USAF R&M 2000 Process", Oct 88.

Conclusions

This review has focused on the literature discussing management roles, especially problem solving patterns, decisional views and the characteristics of management work. The manager's day is characterized by numerous interruptions and short bursts of activity. The utility of computerizing standard output and problem solving in the program manager's office was discussed. Computerization has many benefits that outweigh the possible disadvantages. Producing standardized output from the program manager's office can save time and increase productivity.

A manager can make a better decision with more information. A good decision support system makes information available quickly and easily. Decision support systems help managers learn different techniques for problem solving. However, if the computer programs are difficult to learn or do not satisfy the office's goals, many of those gains are lost. Dangerous computerized decision errors must be prevented in order for managers to accept the decision support systems. Computer hardware compatibility is also vital.

The literature concludes that even though there are many tools available to the program manager, the tools are not used very often. Mintzberg would attribute this to the lack of immediacy of the information. The time involved in setting up the new system may be another detriment. Before any decision support system is implemented, all of these factors should be considered.

Do system acquisition program managers resist using quantitative decision support techniques because the techniques aren't computerized? The hypothesis is that if program and project managers are taught to use a computer to perform the difficult computations of a quantitative decision support technique, they are more likely to apply that technique, and possibly others, to actual problems that occur in their respective jobs. A research experiment was conducted to investigate this question. Chapter III describes the methodology of this experiment. Chapter IV presents the results of the experiment. Chapter V discusses the conclusions and the recommendations for future research.

III. Methodology

Introduction

Do system acquisition program managers resist using quantitative decision support techniques because the techniques aren't computerized? A research experiment was conducted to investigate this questions. This chapter describes the methodology used to study that problem.

System acquisitions program managers rarely use quantitative decision support techniques to aid their decision making. The hypothesis is that if program and project managers are taught to use a computer to perform the difficult computations of a quantitative decision support technique, they are more likely to apply that technique, and possibly others, to actual problems that occur in their respective jobs. To test this hypothesis a research experiment was developed. The experiment included the treatment of teaching decision tree analysis with a computerized decision support system. Approximately three months after the treatment, a after-course survey was administered to determine the results of the treatment. The survey results were analyzed to address the hypothesis. This chapter describes the quasi-experiment, the survey and the analysis techniques used. The results of the analyses are presented in chapter IV.

Quasi-Experiment

This study attempted to determine if altering a part of a Professional Continuing Education (PCE) course for Air Force system acquisition managers affected the frequency that those program managers use quantitative decision support techniques. This was accomplished by conducting a posttest-only design with nonequivalent groups quasi-experiment (7:98). This type of quasi-experiment is a research experiment conducted on a control group and a treatment group with similar average member demographics not controlled (7:34).

The main problem with this type of test design is there is no pretest to compare posttest results with (7:149). Therefore, differences in the results could be treatment orgroup member selection (7:149). This problem is minimized by careful and rigorous examination of the groups' demographics and the other variables that are present (7:149). The control group's posttest results were compared to the treatment group's posttest. The same type of comparisons were made as if a pretest was available.

The following limitations constrained the scope of this research:

1. A quasi-experiment was chosen because a large random sample of project managers could not be independently and randomly gathered to participate in and to complete the after-course survey before the deadline of this research.

2. Interviews with the selected course director ruled out using a control group and a treatment group from the same PCE class. The concern was that the control group students might have become dissatisfied because they might perceive that they were made to do more work than the treatment group students.

3. A pretest was not used because one of the control classes, chosen to insure an evaluation of a large enough number of students for this effort, had already completed the course before this research started. If the experiment was delayed to administer a pretest, there would not have been enough students taught before the research deadline.

Student Selection. The students attending the Intermediate Program Management (SYS-400) course were selected because one of the course prerequisites is that the student's primary job is related to Air Force system acquisition and program management (42). Other reasons for using the SYS-400 students were: the selection of the individual student is considered random when comparing one class to another; course prerequisites and student availability are the main criteria for selecting a student for a specific class (42); and the course already presented a quantitative decision support technique in its curriculum.

Four classes of approximately twenty-five students each were selected for this research, the first two for the control group and the second two for the treatment group, resulting in about fifty program managers in each group.

This number of students was large enough to allow for the typical, sixty percent, survey return rate, while allowing for a statistically large enough sample, thirty, of the population of interest to conduct the appropriate statistical analyses. Only those students that satisfactorily completed the entire course of instruction were sent surveys.

Two techniques were used to minimize variable effects other than the treatment variable. First, external environmental affects were minimized. Then the instruction variability was minimized. External environmental effects are changes in the experiences, societial and personal,of the group members that aren't controlled or measured by the experiment (26:326). An example of an external environmental effect would be a change in the management philosophy of the organization or society. If this change in attitude occurred between the control group measurement and the treatment group measurement, it could cloud the true treatment effect. To minimize this potential, the control group consisted of the last two classes of SYS-400 before the treatment was applied. This was done to allow any external environmental effects, not measured in the survey instrument, to have the same impact on both the control and treatment groups, thus cancelling the effect of those extraneous variables.

The other minimization technique was to use the same instructor for both the control and treatment groups. This minimized the variability of instruction. The course instructor was a highly experienced instructor who had taught the course many times before this experiment began. Further, the instructor had taught the decision analysis block of instruction twice before the control group instruction. This eliminated the effect of an instructor improving his teaching techniques significantly, as an inexperienced instructor does, from the control group to the treatment group.

Instruction. The instruction on decision tree analysis consisted of a reading assignment, an in-class example of the calculations involved, discussion of risk analysis and sensitivity analysis and the in-class exercise using decision tree analysis in a hypothetical case study. The instruction and the in-class exercise lasted six hours, four hours on a Friday and two hours the following Monday. The treatment didn't change the topics covered, the time allowed or the instructor.

Selection of Treatment. Several different computer programs were evaluated. The selection criteria were:

1. Compatible with the existing personal computers available to the PCE class, a Zenith Z-248 or a Zenith PC Laptop. These type of computers are commonly available at the students own work sites.

2. Easy to learn, less than one hour, so not to detract from learning decision tree analysis.

3. Fulfills requirements of the exercise presented in the current PCE curriculum.

4. Obtainable through existing DoD contracts, public domain, or cost less than fifty dollars. Low cost was specified to improve the chances that the students could easily obtain the software after returning to their respective jobs.

The computer decision support system (DSS) was not limited to only the technique that was taught. It could include several different quantitative decision support techniques. The program was selected to be easy to use forthe computer novice, versatile in the type of problems available for analysis, compatible with other computer programs that the student might use at the program office and easy to change parameters to answer ad hoc questions.

The program was selected three weeks prior to the treatment group's first day of class. Strategic Decision Group's Supertree decision tree analysis program, Student Edition, was chosen. It was chosen because of the menu interface, compatibility with popular spreadsheet programs and very large varied decision tree analyses were available (35:238,240).

The program was installed on the Zenith PC Laptop. A menu was used to select the program. This isolated the novice computer user from having to learn the software commands and the operating system. The program was demonstrated to the course's instructor. The demonstration included accomplishing the in-class exercise that needed the decision tree analysis technique.

<u>The Treatment</u>. This experiment was conducted on two groups of project managers. Each group was taught how to conduct a decision tree analysis. The control group (two SYS-400 classes) was instructed on the manual method of using a quantitative decision support technique. The treatment group was instructed on how to use a personal computer (PC) decision support system (DSS), Supertree, to perform the same calculations required of the decision tree analysis by the control group.

No changes were made in the current method of instruction. For both the control and treatment groups, decision tree calculations and the in-class exercise were explained in the previous night's reading assignment. In class, a decision tree analysis example was demonstrated. The in-class exercise was explained and the class separated into four teams to solve the class exercise.

Each member of the treatment group was given a user's guide that demonstrated how to use the software. The guide explained only the commands necessary to accomplish the decision tree analysis of the required class exercise. The example shown in the guide was the example used by the instructor, in class, to teach decision tree analysis. This user's guide is found in Appendix A.

The course instructor monitored the amount of the time both groups used to accomplish the class exercises using the decision tree analysis technique. The instructor was interviewed after each of the treatment classes. Comparisons between the control and treatment groups were made. The amount of time to accomplish various parts of the instruction and the in-class exercise were recorded. The same amount of time was allotted for the instruction and the exercise for all of the classes. This may be an indication of how easily the technique may be used in the program manager's actual work situation.

Measurement

The purpose of the after-course survey instrument was to measure the respondents familiarity with and use of several quantitative decision support techniques after attending the SYS-400 course. Questions were asked about their perceptions of the possible benefits of computerizing decision support techniques and how many techniques are available on a computer. Demographic and responsibility area questions were also asked to determine if they might have affected the measurement of the treatment effect.

If the demographics varied considerably between the control and treatment groups, then these differences could disguise the treatment effect. The responsibility area frequency questions were asked to determine the respondent's program responsibility. If the respondent never made any decisions affecting the program, the survey would be removed. It was assumed that decision support techniques wouldn't be used by a nondecision maker from this group.

The control group and the treatment group were surveyed three months after course completion. The same after-course survey was used for both groups. The survey was developed from a previous survey administered to a large random sample of Air Force program managers. That survey was conducted in 1985 by Roger D. Koble, a Master of Science degree recipient of the Air Force Institute of Technology. This survey was chosen because of the high response rate and the high reliability of the responses that were measured.

This survey's demographic information and attitude measures of quantitative techniques were modified from Koble's. Other demographic categories, age group, computer experience and computer use at work were added. The modifications to the survey focused on (1) determining how often the subjects have used quantitative decision support techniques and (2) determining student computer experience. These categories were added to better determine other effects than the treatment effect. This after-course survey is found in Appendix B.

Several survey construction techniques were used to increase the response rate, the number of surveys completed and returned versus the number sent out (17:165-173). The survey had eighty-one questions and was seven pages long, less than the proposed 125 item and eleven page limits (17:55). Surveys that are longer than those limits tend not to be completed and returned. Upper case letters were used for the answers and normal capitalizations were used for the questions. This aided the respondent to identify the distinction between the questions and answers without really noticing (17:133). The printed question layout was controlled so that the questions guided the respondent from the top of the page to the bottom (17:137). Directions were provided when needed(17:138). Precisely worded close-ended questions with ordered answer choices were used.

> This question structure is ideally suited for determining such things as intensity of feeling, degree of involvement, and frequency of participation. This type of question uses the information supplied by respondents to determine the extent to which each respondent differs from every other one. Thus responses to such questions are well suited for many forms of sophisticated analyses (e.g., regression analysis). (17:89)

The survey was composed with the guidance of several experts of survey construction and several experts in the field of program management. These experts, along with five program mangers not participating in the quasi-experiment, were involved with the testing of this instrument (17:156-157). The results of the testing were used to modify the survey so that it would be clearer to the respondents and more focused on the objectives of this research.

The cover letter was composed in accordance with AFIT Operating Instruction 53-10. The letter explained to the respondent why this after-course survey was important, the respondents importance to the study and to minimize any questions the respondent may have had. This letter provided the researcher's mailing address and phone number should the respondent need additional information. Confidentiality was assured. The cover letter gave instructions to request study results should the respondent desire them. To further increase the response rate, the cover letter was printed on colored letterhead, with specific dates and personalized salutations. The cover letter was signed by the course director in blue ink and on a soft surface to leave a slight indentation. This left "unmistakable evidence that the signature is real" (17:173).

Several more steps were taken to increase the response rate. All of the contents were inserted into the envelope so everything would be removed together and nothing would accidentally be left in the mailing envelope. A preaddressed return envelope was provided (17:178-180). No postage was necessary because the military mail distribution system was used. Because of the small size of each experiment group, about twenty-five, the researcher attempted to contact each respondent by phone. This was done the day before and the day of the surveys being mailed. Several members were able to provide address corrections and forwarding instructions.

Analysis

The analysis focused on the weakness of the experiment design, nonequivalent groups. The analysis started with theminimum number of assumptions about the responses' data levels and distributions. Two assumptions, the categorical (nominal) data level and the unknown distributions of the responses, meant nonparametric statistical tests should be used. Since some of the responses were written on a Likert scale, parametric tests could also be used in the analysis. A Likert scale is ordinal data but is sometimes considered interval if equal intervals between the answers are assumed (10).

All of the terts used in this analysis provided a probability that the sample distributions were similar. If the probability was lower than alpha, then the distributions could be considered different. Alpha is the test percentage error that the researcher is willing to except, of determining that the samples are dissimilar when they actually aren't (39:138-139). The tests are not conclusive on why the difference exists, but only that there is a difference.

The respondents answers to the demographic and responsibility area questions were analyzed first. The surveys were separated into the control and treatment groups and compared. This helped determine if the control and treatment groups were from the same larger population. If the demographics and responsibility areas varied significantly, then few conclusions could be drawn about the effect of the treatment.

The respondent's demographic and responsibility area categories might have caused the type of response on the different decision support techniques to vary. Table 1 shows the categories to questions one through eleven and the hypothesized influence on frequency of technique use that might have disguised the effect of the treatment.

Table 1

Hypothesized Demographic Influence on Frequency of Use

#	Question's Subject	Hypothesized Influence on Use
1.	Product Division	Unknown
2.	Rank	+
3.	Academic Degree	+
4.	Field of Study	- Busi/Oth + Eng/Sci
5.	SPO Type	Unknown
6.	Job Position	-
7.	# Yrs Experience	+
8.	Age	+
9.	Acquisition Phase	+/-
10.	Computer Familiar	+
11.	Computer Work Use	+
12.-31.	Responsibility	Unknown

The responses to the main responsibility areas were compared to the responses to the specific responsibility areas. This was done to test the consistency of the respondents' answers. The higher the reliability, the more consistent the responses. The responses to quantitative decision support technique familiarity and frequency of use were compared next. The possible effect of differing demographics on the responses to each of the decision support techniques was then examined. Results of the computerized benefits and computer program availability were then tabulated and reported.

<u>Tests</u>. If the survey contained obvious mistakes, it was removed from the analysis. The responses to questions seventy-two through eighty-one, the two optional "OTHER" quantitative decision support techniques, were combined with the appropriate category from questions thirty-two through seventy-one. Any survey response that was not answered, was not used in a test.

Alpha analysis was used to test the reliability and validity of the respondent's answers to the responsibility area survey questions, question twelve through thirty-one. Five main areas were asked in questions twelve through sixteen. Questions seventeen through thirty-one asked more specific responsibility areas in the five main areas. The respondents' answers were tested to see if they answered similarly to questions that related to each of the main areas. This tested the reliability and consistency of the respondent's answers in each of the five areas.

All of the responses were compared with a Chi squared (X^2) test of homogeneity, a test for similarities between separate groups. This was used to determine whether the respondents could be from the same population. The test determines "whether the relative frequency distribution [of the responses compared between the groups] are the same" (38:4.3). This test was used to determine if the control and treatment groups demographics were different from each other. The X^2 test doesn't assume a specific population distribution. The test compares the responses of each group and tests if the responses are related to the control versus treatment category or if they could be from the same overall group.

A test more sensitive to differences in the distributions of two samples than the X^2 test is the Wilcoxson Rank Sum test. The additional assumption from the X^2 test is the data level has to be ordinal or higher.

Each of the demographic questions were examined to see if the range of responses for each category, in the demographic question, resulted in similar distributions of responses to the questions for each technique category. The Kruskal-Wallis one way analysis of variance was used.

> Kruskal-Wallis test is a generalization of the rank-sum test. Tied values are assigned their average rank. If each of the groups had similar distributions, the mean rank for all groups would be expected to be 'similar'. (38:6.18)

If respondents of one or more demographic category tended to respond differently from the other categories, then this could effect the results of the analysis of the treatment. The observed effect of the treatment might be clouded by the effect of a demographic category.

A test more sensitive to differences than the X^2 and the Rank Sum is the Student's t test. The Student's t statistical test was used to compare the survey responses of the questions that could be considered interval data. A

Student's t test was used since the actual mean and standard deviation of the overall population was unknown. The Student's t test assumes that the responses were obtained independently and that the sample was from a range of responses from an overall population whose responses would be mound shaped distributed (39:174-175). If there is a difference, the probability will be less than the confidence level probability used for comparison, alpha.

Summary

To test the hypothesis, the frequency of using quantitative decision techniques changes if a technique is taught with the aid of a computerized decision support system. A posttest-only design with nonequivalent groups quasi-experiment was conducted. The groups were selected from the Intermediate Program Management (SYS-400) Professional Continuing Education (PCE) course at Wright-Patterson AFB OH. The course teaches decision tree analysis. The treatment was to introduce the decision analysis with the aid of Strategic Decision Group's Supertree program, Student Edition. A after-course survey was developed to measure the effects of the treatment. Several techniques were used to increase the survey response rate. The analysis started with as few assumptions as possible. Tests were conducted to determine the control and treatment groups' similarities and differences. Higher level tests were used only when the assumptions were valid. The results of the analysis are in chapter IV.

IV. Results

Introduction

This chapter addresses the results of the quasi-experiment described in chapter III. The hypothesis tested was if program and project managers are taught to use a computer to perform the difficult computations of a quantitative decision support technique, they are more likely to apply that technique, and possibly others, to actual problems that occur in their respective jobs. These results were measured by the responses from the three month after-course survey. The analysis attempted to determine the effect of the treatment and to identify any variables that might disguise the treatment effect. The conclusions from this analysis and recommendations for future research are presented in chapter V.

In-Class Exercise

The Intermediate Program Management (SYS-400), Professional Continuing Education (PCE) course at Wright-Patterson AFB OH, classes that were used in this study are listed in Table 1. The group class dates, exercise dates and number in each class that completed the curriculum are shown.

Table 2

Experiment Group Information

Group	SYS-400 Dates	Exercise Dates	Group Size
Control			
89A	17-28 Oct 88	21-24 Oct 88	24
89B	5-16 Dec 88	9-12 Dec 88	24
Treatment			
89C	23 Jan - 3 Feb 89	27-30 Jan 89	23
89D	21 Feb - 3 Mar 89	24-27 Feb 89	24

The instructor stated that, as a whole, the control group teams had gotten tired by the end of the manual decision tree calculations and had lost their motivation to do much sensitivity and risk analysis in the in-class exercise. The exercise was laborious, with many manual mathematical calculations. None of the control group teams were finished by Friday afternoon. Many teams felt exhausted and elected to stop thirty to forty-five minutes early. They completed the rest of the calculations on Monday morning.

The treatment group teams were observed voluntarily staying an average of 50 minutes longer than the control group teams and to be in better spirits during and after the exercise. The majority of the treatment group teams finished on Friday afternoon with only a few minor points left to complete Monday morning. Therefore, the treatment group teams had more discussion time available on Monday.

The instructor stated that the treatment groups were able to receive a more detailed discussion on the in-class exercise and the lesson. The time to complete the in-class exercise was difficult to measure because the treatment groups developed overhead slides and refined their output's appearance. By direct observation, the impression of the instructor and this researcher is that the treatment group teams completed the same tasks as the control group teams in less time. Only two to three members on each team in the treatment group actually used the computer to do the computations that were required. This was comparable to the control groups where only one or two members per team did the manual calculations.

The end-of-course exam did not show any significant differences in the test scores on decision tree knowledge. Both groups showed a high degree of understanding, 85%.

The end-of-course critiques were similar between the groups, although some did comment positively on the computer based exercise. The only drawback reported by the students was the amount of time the program took to complete the required calculations. Even though it was much faster than computing the analysis manually, it appeared slow to the user.

The Survey Results

The after-course surveys were mailed thirteen work weeks after course completion. Table 3 shows the schedule used. This schedule was chosen because of the Thanksgiving and Christmas holidays. Work weeks were used to determine the mailing time. This allowed each group to have the same amount of time to have program problems that decision support techniques could be used to aid solving after returning to their respective jobs.

Table 3

Survey Timing and Response Rates

Group	Survey Dates	Response Size	Response Rate
Control			
89A	13 Feb 89	22	92%
89B	13 Mar 89	19	79%
Treatment			
89C	8 May 89	17	74%
89D	5 Jun 89	18	75%

Response Rate. Surveys were mailed to all ninety-five subjects, forty-eight to the control group and forty-seven to the treatment group. Telephone contact with all subjects was attempted on the day before and the day the after survey was mailed. If the subject couldn't be contacted in those two days, a message was left. Eighty-five percent and seventy-four percent of the control and treatment group surveys were returned, respectively. Since the response rate was above the needed sixty percent, no further attempt to contact the subjects were made.

All but one of the surveys was determined to be valid. This was a treatment subject survey which selected the first response, 1, for all of the questions, except for the demographics. The remarks in this survey stated that the respondent didn't work in a program office; therefore, all of the questions were "Not Applicable". Consequently, this survey was removed from the analyses.

Demographics. The demographic characteristics of both groups are shown in Table 4. The responses of both groups were distributed similarly across all of the demographic questions. Aeronautical Systems Division was the dominate product division represented. Over 80% had completed a graduate curriculum. Approximately half of the fields of study, both undergraduate and graduate, were in engineering, science and/or math. Over 40% were in business and/or management. Over 60% worked in a system program office. About half stated that they are currently program or project managers. All phases in the acquisition process were represented. More than three quarters felt that they are at least moderately familiar with personal computers and/or mainframe computers. Nine out of ten use a computer every day.

Table 4

Frequency Counts of Responses to Demographics

QUESTION	RESPONSE	CONTROL FREQUENCY	CONTROL %	TREATMENT FREQUENCY	TREATMENT %
1.PRODUCT DIVISION	ESD	1	2.4	0	0.0
	ASD	25	61.0	21	61.8
	SD	0	0.0	1	2.9
	OTHER	15	36.6	12	35.3
2.RANK	CAPT & BELOW	6	14.6	7	20.6
	MAJOR	13	31.7	16	47.1
	LTC & ABOVE	14	34.1	4	11.8
	GM/GS-12 & LOW	2	4.9	1	2.9
	GM/GS-13 & ABV	6	14.6	6	17.7
3.HIGHEST DEGREE	BACHELORS	5	12.2	6	17.6
	MASTERS	35	85.4	26	76.5
	DOCTORAL	1	2.4	1	2.9
	NONE	0	0.0	1	2.9
4.FIELD OF STUDY	ENGINEERING	22	39.3	18	36.7
	SCIENCE/MATH	10	17.9	6	12.2
	BUSI/MNGNT	23	41.1	21	42.9
	NONE OF ABOVE	1	1.8	4	8.2
5.SPO TYPE	BASKET	10	24.4	10	29.4
	SINGLE SYS	16	39.0	13	38.2
	OTHER	15	36.6	11	32.4
6.JOB POSITION	DIRECTOR	0	0.0	0	0.0
	PGM MNGR	11	26.8	13	38.2
	PRJT MNGR	6	14.6	5	14.7
	OTHER	24	58.5	16	47.1
7.CUMULATIVE EXPERIENCE	NONE	5	12.2	2	5.9
	1 YR	2	4.9	3	8.8
	2-3 YRS	11	26.8	7	20.6
	4-6 YRS	12	29.3	9	26.5
	ABV 6 YRS	11	26.8	13	38.2

Table 4 (Continued)

Frequency Counts of Responses to Demographics

QUESTION	RESPONSE	CONTROL FREQUENCY	CONTROL %	TREATMENT FREQUENCY	TREATMENT %
8.AGE GROUP	UNDER 30	1	2.4	1	2.9
	30 - 35	8	19.5	14	41.2
	36 - 40	17	41.5	12	35.3
	41 - 45	10	24.4	5	14.7
	OVER 45	5	12.2	2	5.9
9.ACQ PHASE	NO ANSWER	3	N/A	8	N/A
	CNCPT EXPLR	8	14.3	11	18.6
	DEM/VAL	9	16.1	15	25.4
	FULL SCALE	20	37.5	19	32.2
	PROD & DEPL	18	32.1	14	23.7
10.COMPUTER FAMILIARITY	NONE	2	4.9	1	2.9
	SLIGHTLY	8	19.5	2	5.9
	MODERATELY	16	39.0	19	55.9
	VERY	7	17.1	7	20.6
	COMPLETELY	8	19.5	5	14.7
11.COMPUTER USE	NEVER	3	7.3	2	5.9
	< 1 HR/DAY	12	29.3	9	26.5
	1-2 HR/DAY	16	39.0	13	38.2
	3-4 HR/DAY	7	17.1	5	14.7
	> 4 HR/DAY	3	7.3	5	14.7

X^2 Test. The X^2 test of the demographic questions is shown in Table 5. The test suggests that the sample populations are from the same overall population for values of alpha up to 0.05. The only demographic category that could be rejected, if one uses an alpha of 0.10, as coming from the same population is Age Group. An alpha of 0.10 was selected because the sample population, ninety-five, is small when compared to the entire system acquisition program manager population. The hypothesis tested was that the sample populations were from the same overall population.

The alternate hypothesis was that the sample population are somehow different. There was no assumption of the population distribution. The data level required for this test is categorical or higher. The initial conclusion is that the demographics are similar enough to conclude that both groups belong to the same larger population. This conclusion means that any differences in other variables might be attributed to the effect of the treatment.

Table 5

X^2 Results of Comparison between Control and Treatment Groups' Demographics

Question	X^2	df	Probability
1. Product Division	0.013	1	0.908
2. Rank	5.672	4	0.225
3. Highest Degree	0.974	1	0.324
4. Field of Study	2.837	3	0.416
5. SPO Type	0.275	2	0.872
6. Job Position	1.215	2	0.545
7. Cumulative Experience	1.174	3	0.579
8. Age Group	4.658	2	0.097
9. Acquisition Phase	2.362	3	0.501
10. Computer Familiarity	4.101	3	0.251
11. Computer Use	0.275	2	0.872

<u>Wilcoxon Rank Sum Test</u>. The Wilcoxon Rank Sum test of the demographic questions is shown in Appendix C. As with the X^2 test, this test suggests that the sample populations are from the same overall population for values of alpha up to 0.05. The only demographic category that might be rejected as coming from the same population is AGE

GROUP, if one accepts an alpha of 0.10. There was no assumption of the population distribution. The data level required for this test is ordinal or higher. The only question that can't translate into ordinal data is PRODUCT DIVISION. The test for PRODUCT DIVISION would still show a tendency that the sample populations might be different if the probability was low. Since the probability is very high, the conclusion is that the respondents came from the same overall population.

The conclusion from both tests is that the demographics are similar enough to conclude that both groups belong to the same larger population. The AGE GROUP category was investigated later, with the Kruskal-Wallis test, for effects on the treatment. That means any differences in the other variables might be attributed to the effect of the treatment.

Responsibility Areas.

Reliability Test. A reliability test was used to test for consistency in the respondents' answers. Each of the five major area answers, questions twelve through sixteen, were compared to the answers of the specific area response, questions seventeen through thirty-one. The major area responses were then compared with the questions that were included to test reliability. The results are shown in Table 6. The very high reliability scores show the respondents were consistent in their responses for questions twelve through thirty-one. This leads to the conclusion that each respondent was trying to answer the survey questions as thoroughly as they could.

Table 6

Survey Reliability Test Results

Question Range	Reliability Alpha
12, 17-31 12, 20, 27, 31	0.8820 0.7110
13, 17-31 13, 18, 26, 28	0.8869 0.8365
14, 17-31 14, 22, 25, 29	0.8861 0.7647
15, 17-31 15, 17, 21, 23, 30	0.8844 0.7893
16, 17-31 16, 19, 24	0.8798 0.8314

Since the responses were so consistent, only the responses to questions twelve through sixteen were used to analyze the responses to responsibility areas.

X^2 Test. The X^2 test shows that both the control group and the treatment group have similar responsibilities in their program office. Only the responses in the LOGISTICS area approached being significantly different. Appendix D shows the results of the tests for the main responsibility areas and the results for the more specific responsibility areas, grouped by main area.

The conclusion from this analysis is that the control and treatment groups have similar levels of responsibility in their program office and in the same areas, except possibly in the LOGISTICS area.

<u>Wilcoxon Rank Sum Test</u>. The Wilcoxon Rank Sum test showed that both the control group and the treatment group responses were similar. Again, the only difference appeared in the LOGISTICS area, when compared to alpha of 0.10. The results are shown in Appendix E.

This confirms the X^2 analysis. Both the control and treatment groups had similar levels of responsibility in their program office and in the same areas, again except in the LOGISTICS area.

<u>Student's t Test</u>. The Student's t test confirmed that the sample populations are for a similar overall population. The results are shown in Table 7. All three tests confirmed each other. In the treatment group, more decisions in the LOGISTICS area were made. This shows that the data level assumption was acceptable and the tests had a high degree of reliability.

The conclusion from these analyses is that both the control and treatment groups had similar levels of responsibility in their program office and in the same areas, except possibly in the LOGISTICS area. The LOGISTICS area was analyzed later, with the Kruskal-Wallis test, for effects on the treatment variables.

Table 7

Student's t Test Results of Comparison between Control and Treatment Groups' Responsibility Areas

Question	t	df	Probability
12. Cost and Budget	-1.345	71.4	0.1829
13. Schedule	-0.035	72.8	0.9721
14. Technical Performance	0.164	71.2	0.8701
15. Logistics	-2.238	70.7	0.0284
16. Admin of Pgm Personnel	1.163	70.3	0.2487

Quantitative Decision Support Techniques. A alpha of 0.10 was selected because the sample population, ninety-five, was small, forty-one and thirty-four, when compared to the entire system acquisition program manager population. Any probability less than 0.10 meant that the distributions were not similar.

X^2 Test. The X^2 test was used to determine if there were any differences between the control and treatment group's responses without assuming a high data level or response distribution. The results are presented grouped by quantitative decision support technique category.

The test showed that the control and treatment groups were different on decision support technique Familiarity for the Statistical Analysis, Linear Programming, Simulation, Project Selection and Financial Methods categories.

The test showed that the control and treatment groups were different on the technique Use frequency for the

Statistical Analysis, Linear Programming and Financial Methods categories.

The test showed that the control and treatment groups were different on the technique comruterization Benefit for the Linear Programming, Simulation, Project Selection and Financial Methods categories.

The test showed that the control and treatment groups were different on the technique computer program Availability for the Statistical Analysis and Financial Methods categories.

The test showed that the control and treatment groups were different on the technique use Opportunity only for the Financial Methods category.

The detailed test results are in Appendix F. Table 8 summarizes the categories that were different by technique question area. The X means a difference between the control and treatment groups.

Wilcoxon Rank Sum Test. In the Wilcoxon Rank Sum test for technique Familiarity, Statistical Analysis, Linear Programming, Simulation, Project Selection and Financial Methods categories were different between both groups. These results agreed with the X^2 test results.

Table 8

Summary of Differences found Through X^2 Test of Comparison between Control and Treatment Groups to the Quantitative Decision Support Technique Questions

Category	Technique Question Area				
	Familiar	Use	Benefit	Available	Opportunity
Statistical Analysis	X	X		X	
Linear Programming	X	X	X		
Simulation	X		X		
Project Selection	X		X		
Decision Theory					
Ranking					
Networking					
Financial Methods	X	X	X	X	X

X means a Difference between the Control and Treatment Groups

The test for technique Use frequency, Statistical Analysis and Financial Methods categories were different between both groups. Linear Programming did not test as being different as in the X^2 test. This could mean that there wasn't a treatment effect on Linear Programming decision support technique.

The test for technique computerization Benefit, Financial Methods category was different between both groups. Linear Programming and Simulation did not test as being different as in the X^2 test. This could mean that there wasn't a treatment effect on Linear Programming and Simulation decision support techniques.

The test for technique computer program Availability, Financial Methods category was different between both groups. Statistical Analysis did not test as being different as in the X^2 test. This could mean that there wasn't a treatment effect on Statistical Analysis decision support technique.

The test for technique use Opportunity of Financial Methods category was different between both groups. These results agreed with the X^2 test results.

The detailed demographic test results are in Appendix G. Table 9 summarizes the categories that were different by technique question area. The X means a difference between the control and treatment groups.

<u>Student's t Test</u>. The Student t test showed that the control and treatment groups were different on decision support technique Familiarity for the Statistical Analysis, Linear Programming, Simulation, Project Selection and Financial Methods categories. The detailed results are in Appendix H.

The means and standard deviations for the responses are listed in Appendix I. The treatment group averages were all higher.

Table 9

Summary of Differences found Through Rank Sum Test of Comparison between Control and Treatment Groups to the Quantitative Decision Support Technique Questions

Category	Technique Question Area				
	Familiar	Use	Benefit	Available	Opportunity
Statistical Analysis	X	X			
Linear Programming	X				
Simulation	X				
Project Selection	X				
Decision Theory					
Ranking					
Networking					
Financial Methods	X	X	X	X	X

X means a Difference between the Control and Treatment Groups

Statistical Analysis, Linear Programming and Financial Methods were different for Use frequency.

The test showed that the control and treatment groups were different on the technique computerization Benefit for the Linear Programming, Simulation, Project Selection and Financial Methods categories.

The control and treatment groups were different on the technique computer program Availability for the Statistical Analysis and Financial Methods categories.

The test measured the control and treatment groups difference on the technique use Opportunity only for the Financial Methods category.

Table 10 summarizes the categories that were different by technique question area. The X means a difference between the control and treatment groups.

This leads to the conclusion that the treatment did cause the differences between the two groups for those categories.

Table 10

Summary of Differences found Through Student's t Test of Comparison between Control and Treatment Groups to the Quantitative Decision Support Technique Questions

Category	Technique Question Area				
	Familiar	Use	Benefit	Available	Opportunity
Statistical Analysis	X	X			
Linear Programming	X	X			
Simulation	X				
Project Selection	X			X	
Decision Theory					
Ranking					
Networking					
Financial Methods	X	X	X	X	X

X means a Difference between the Control and Treatment Groups

Kruskal-Wallis Test. The Kruskal-Wallis test examined the distribution of responses by each demographic response category and the LOGISTICS responsibility area variables. The surveys were not separated into control and treatment groups. When the distributions across all variable responses are similar, that suggests the variable did not effect the responses to the other questions, like frequency of technique Use. The variables that were not distributed similarly across the range of responses might have disguised the treatment effect.

The observed treatment effects for Familiarity were in Statistical Analysis, Linear Programming, Project Selection and Financial Methods. Statistical Analysis, Linear Programming and Financial Methods were different for technique Use. Project Selection was different in technique Availability. The Financial Methods technique was also different for technique Benefit, Availability and use Opportunity. These techniques were specifically examined for variable effects other than the treatment. All of the variable effects for all of the techniques are reported for a better understanding of the variable influence.

The demographic category, AGE GROUP, and responsibility area, LOGISTICS, were the only variables different between the control and treatment groups. AGE GROUP was distributed evenly across the range of all responses, except one. AGE GROUP did have a difference for technique computerization Benefit in Project Selection. Those respondents under thirty and over forty-five marked the Benefit higher than the other AGE GROUP respondents. This meant that despite the differences between the control and treatment group's distributions for AGE GROUP, it had no measurable treatment effect on Use frequency.

The responsibility category, LOGISTICS, was not distributed evenly across the range of responses. For the treatment effected techniques, Project Selection, Financial Methods Familiarity LOGISTICS had a positive effect. This meant low levels of LOGISTICS responsibility marked low Financial Methods Familiarity. The high levels of LOGISTICS responsibility marked high Financial Methods Familiarity. Linear Programming and Financial Methods were treatment effected techniques. The technique change might have been attributed to the Logistics variable and not the treatment.

Table 11 shows the technique Familiarity differences and the influences for all of the variables. For Tables 11 through 15, a plus or minus is the direction the variable category influenced the decision support technique variable. The minus shows a lower technique variable response and the plus means a higher technique variable response. For example, the plus in COMPUTER USE meant a lower category response marked lower technique response. The minus in ACQUISITION PHASE meant that the earlier a program is in the acquisition cycle, the higher the technique response.

Table 11

Kruskal-Wallis Test for Influence of Demographic and Logistic Categories on Technique Familiarity

# Question's Subject	Observed Influence on Familiarity
Statistical Analysis	
10. Computer Familiarity	+
Linear Programming	
2. Rank	-
5. SPO Type	- SPO + Other
6. Job Position	- Pgm + Other/Pjt
9. Acquisition Phase	-
10. Computer Familiarity	+
11. Computer Use	+
Simulation	
9. Acquisition Phase	-
10. Computer Familiarity	+
Project Selection	
15. Logistics	+
Decision Theory	
3. Highest Degree	+
10. Computer Familiarity	+
15. Logistics	+
Ranking	
9. Acquisition Phase	-
15. Logistics	+
Networking	
2. Rank	-
10. Computer Familiarity	+
Financial Methods	
7. # Yrs Experience	-
15. Logistics	+

\+ Higher Technique Familiarity for Higher Category Response
\- Lower Technique Familiarity for Higher Category Response

AGE GROUP and LOGISTICS didn't effect the treatment effected techniques for the Use frequency variable.

For technique Use frequency, LOGISTICS did have a difference for Decision Theory and Ranking. The very high and very low responsibility levels marked the Decision Theory low Use frequency. The midlevels of responsibility markea Decision Theory higher. The higher the responsibility, the more Use frequency with the Ranking technique.

In the PRODUCT DIVISION category, Aerospace Systems Division (ASD) measured lower than the Other response in Decision Theory, Ranking and Financial Methods for the technique Use frequency. The Other response consisted of managers assigned to test centers, Air Force major command headquarters, Ballistic Missile Systems Division, etc.

Those that identified themselves as Program Managers generally used Statistical Analysis, Linear Programming and Simulation less than those that identified as Project Managers or Other. The Other responses included test engineer, division chief, branch chief, etc.

ACQUISITION PHASE response categories and technique Use were related, the earlier the PHASE, the more often they used the techniques.

Table 12

Kruskal-Wallis Test for Influence of Demographic and Logistic Categories on Technique Use Frequency

# Question's Subject	Observed Influence on Use	
Statistical Analysis		
5. SPO Type	- SPO	+ Other
6. Job Position	- Pgm	+ Other/Pjt
Linear Programming		
6. Job Position	- Pgm	+ Other/Pjt
10. Computer Familiarity		+
11. Computer Use		+
Simulation		
5. SPO Type	- SPO	+ Other
6. Job Position	- Pjt/Pgm	+ Other
Decision Theory		
1. Product Division	- ASD	+ Other
7. # Yrs Experience		:
15. Logistics	-High/Low	+ Midlevels
Ranking		
1. Product Division	- ASD	+ Other
7. # Yrs Experience		+
9. Acquisition Phase		-
15. Logistics		+
Networking		
3. Academic Degree		+
Financial Methods		
1. Product Division	- ASD	+ Other
7. # Yrs Experience		+
9. Acquisition Phase		-
11. Computer Use		+

\+ Higher Technique Use for Higher Category Response
\- Lower Technique Use for Higher Category Response

AGE GROUP and LOGISTICS didn't effect the treatment effected techniques for the computerization Benefit variable.

AGE GROUP did have a difference for technique computerization Benefit in Project Selection. Those respondents under thirty and over forty-five marked the Benefit higher than the other AGE GROUP respondents. This meant that despite the differences between the control and treatment group's distributions for AGE GROUP, it had no measurable effect on the treatment effected techniques.

For technique computerization Benefit, LOGISTICS did have a difference for Linear Programming, Project Selection and Ranking. The very high and very low responsibility level generally marked Linear Programming low Benefit. The midlevels of responsibility marked Linear Programming higher. The higher the responsibility, the more Benefit with the Project Selection and Ranking technique.

In the PRODUCT DIVISION category, ASD measured lower than the OTHER response in Ranking for the technique computerization Benefit.

In the FIELD OF STUDY category, the OTHER response was lower than the ENGINEERING, SCIENCE AND/OR MATH and BUSINESS AND/OR MANAGEMENT responses for the technique computerization Benefit of Linear Programming and Project Selection. The OTHER response included Education, Public Administration, English, History, etc.

Table 13

Kruskal-Wallis Test for Influence of Demographic and Logistic Categories on Technique Computerization Benefit

# Question's Subject	Observed Influence on Benefit	
Statistical Analysis		
2. Rank		+
3. Highest Degree		+
Linear Programming		
3. Field of Study	- Other	+ E/S/M/B/M
11. Computer Use		+
15. Logistics		+
Project Selection		
3. Field of Study	- Other	+ E/S/M/B/M
8. Age Group	- Middle	+ High/Low
15. Logistics		+
Decision Theory		
6. Job Position	- Pjt	+ Other/Pgm
Ranking		
1 Product Division	- ASD	+ Other
9. Acquisition Phase		-
15. Logistics		+
Financial Methods		
7. # Yrs Experience		-
11. Computer Use		+

\+ Higher Technique Benefit for Higher Category Response
\- Lower Technique Benefit for Higher Category Response

AGE GROUP didn't effect any of the techniques for the computer program Availability variable.

For technique computer program Availability, LOGISTICS did have a difference for Linear Programming, Decision Theory and Ranking. The higher the responsibility, the more use Opportunity frequency with the techniques. LOGISTICS didn't effect any of the effected treatment techniques.

In the RANK category, the higher ranks marked the lower responses in Linear Programming and Financial Methods for the technique computer program Availability.

In the SPO TYPE category, those that identified themselves as working in a BASKET SPO, computer program Availability of the technique Project Selection was more than the OTHER and SINGLE SPO responses.

AGE GROUP and LOGISTICS didn't effect the treatment effected techniques for the use Opportunity variable.

For technique use Opportunity, LOGISTICS did have a difference for Project Selection and Ranking. The higher the responsibility, the more use Opportunity with the Project Selection and Ranking techniques.

LOGISTICS appears to have influenced the treatment effects for Project Selection and Financial Method techniques. Logistic responsibility effecting financial matters in the program office is logical. However, logistic responsibilities is not normally the overwhelming factor in program office project selection It is concluded that the LOGISTICS effects on Project Selection was coincidental and didn't alter the treatment effect. The Financial Methods effect could be attributed to logistic responsibility, therefore that treatment effect is discarded.

The demographic influences are listed in Appendix J. The detailed results for LOGISTICS influence are presented in Appendix K.

Table 14

Kruskal-Wallis Test for Influence of Demographic and Logistic Categories on Technique Computer Program Availability

# Question's Subject	Observed Influence on Availability	
Statistical Analysis		
1. Product Division	- ASD	+ Other
6. Job Position	- Pgm	+ Other/Pjt
9. Acquisition Phase		-
Linear Programming		
1. Product Division	- ASD	+ Other
2. Rank		-
6. Job Position	- Pgm	+ Other/Pjt
9. Acquisition Phase		-
15. Logistics		+
Simulation		
6. Job Position	- Pgm	+ Other/Pjt
9. Acquisition Phase		-
Project Selection		
5. SPO Type	- Single	+ Other/Bskt
Decision Theory		
7. # Yrs Experience		-
9. Acquisition Phase		-
15. Logistics		+
Ranking		
6. Job Position	- Pgm	+ Other/Pjt
9. Acquisition Phase		-
15. Logistics		+
Networking		
7. # Yrs Experience		+
Financial Methods		
2. Rank		-
7. # Yrs Experience		-
11. Computer Use		+

\+ Higher Technique Availability for Higher Category Response
\- Lower Technique Availability for Higher Category Response

Table 15

Kruskal-Wallis Test for Influence of Demographic and Logistic Categories on Technique Use Opportunity

# Question's Subject	Observed Influence on Opportunity	
Statistical Analysis		
1. Product Division	- ASD	+ Other
5. SPO Type	- SPO	+ Other
6. Job Position	- Pgm	+ Other/Pjt
11. Computer Use		+
Linear Programming		
3. Field of Study	- Other	+ E/S/M/B/M
5. SPO Type	- SPO	+ Other
11. Computer Use		+
Simulation		
1. Product Division	- ASD	+ Other
Project Selection		
11. Computer Use		+
15. Logistics		+
Ranking		
1. Product Division	- ASD	+ Other
15. Logistics		+
Networking		
3. Highest Degree		+
7. # Yrs Experience		-
Financial Methods		
7. # Yrs Experience		-
11. Computer Use		+

\+ Higher Technique Opportunity for Higher Category Response
\- Lower Technique Opportunity for Higher Category Response

<u>Tabulations</u>. For most of the techniques, 75% of the system acquisition program managers were at least moderately familiar. However, only 25% were moderately familiar with Linear Programming and Project Selection techniques. Approximately 10% of the respondents use the techniques,

except Ranking, often or more. Only 19% of the managers use the Ranking technique often or more. The majority believe the techniques would be useful to their decision making, if computerized. Many of the techniques are available on a computer. Few managers report making decisions where these techniques could be used often.

The response frequencies for the decision support questions are in Appendix L. All of the survey data is in included in Appendix M.

Conclusions

The experiment was conducted under similar environments for both the control and treatment groups. This minimizes the effects of external factors disguising the treatment effect. The treatment allowed easier accomplishment of the class work. The uncontrolled group selection produced similar group demographics between the control and treatment groups, except for the Age Group category. Age Group had no measurable effect on the technique variables. This minimized the effect of the differences. The responsibility areas were similar between the groups. The Logistics area probably influenced the treatment effect for Financial Methods technique Familiarity. The responses to the after-course survey were istent for the responsibility areas. The surveys were answered thoroughly by the respondents.

The treatment had a measurable effect on some quantitative decision support techniques variables. The treatment effected Statistical Analysis, Linear Programming Simulation and Project Selection technique Familiarity. The treatment effected Statistical Analysis, Linear Programming and Financial Methods technique Use frequency. The treatment effected Project Selection for computer program Availability. It also effected Financial Methods for computerization Benefit, computer program Availability and use Opportunity. The conclusions from these tests and recommendations for future research are in chapter V.

V. Conclusions and Recommendations

This chapter presents a brief summary of the thesis objective and the methodology used to achieve that objective. Conclusions are drawn from information provided through the methodology which will directly answer the research questions. This chapter discusses overall research conclusions and implications related to the teaching of systems acquisition program manager decision support techniques. It concludes with recommendations for future research efforts.

Summary of the Research

A quantitative decision support technique, decision tree analysis, was taught in the Intermediate Program Management (SYS-400) Professional Continuing Education (PCE) course at Wright-Patterson AFB, OH. Before this research began, the classes were doing the decision tree calculations without the aid of a computer. This study focused on whether modifying the SYS-400 curriculum to teach the use of PC based decision tree computations to program managers would effect the frequency with which they used quantitative techniques in addressing actual program and project problems.

Three months after course completion, an after-course survey was sent to each course graduate. The after-course survey measured the graduate's familiarity with and use frequency of several quantitative decision support techniques. In addition, technique computerization benefits, technique computer program availability and use opportunity were gathered. Demographics and responsibility areas were collected to identify possible effects, other than the treatment effect, obscuring the analysis.

The survey gathered information on several different quantitative techniques in an attempt to measure the effect of the classroom instruction. This study did not try to discover if other teaching techniques or other situations would alter the frequency of quantitative technique use.

Conclusions to the Research Questions

1. How often do system acquisition program managers use quantitative decision support techniques, with or without the aid of a computer?

Very little literature was found. Koble presented some information on the use of statistical analysis techniques; other techniques were not reported. The literature focused on what the manager accomplished, not what tools they used to achieve their goals.

From this study, the majority of the system acquisition program managers were moderately familiar with most techniques. Very few (10%) of the managers use the techniques often. The majority believe the techniques would be useful to their decision making if computerized, which many are. Few managers report decision making opportunities that would allow the use of such techniques.

2. What tools do managers need to problem solve? What do they want to use for help?

The active program manager is always balancing the various demands of schedule, cost, performance, maintainability and numerous other criteria. The manager's staff helps by providing current information, vital to the program manager. Therefore, the manager will establish an organization that provides the most current information. The active manager should use habitually reflective thinking to decipher that information. Habitually reflective thinking is aided by current information, planning and examining the alternatives through the decisional views of economic rational, satisficing, organizational procedures, political views and individual differences, all of which effect the active program manager's choice of solution.

A personal computer is now available to assist the manager in the utilization of this flood of information. Decision support systems (DSS) have been developed to help the manager make more informed decisions providing various options. It is critical that the DSS not take much time to learn, develop or update since the manager's normal schedule of constant interruptions will not allow for this.

This research has demonstrated that a properly designed DSS can be effective in providing current information to the active manager, but only if DSS operates within the manager's decisional views and time constraints.

3. Does a three month after-course survey of the treatment groups provide reliable results that can be compared to the three month after course surveys of the control groups?

The after-course survey did detect differences between the control and treatment groups. Both groups' demographics were similar with two exceptions: the treatment group's lower median Age Group and its higher responsibility level in the Logistics area.

The experiment was conducted under similar environments for both the control and treatment groups which minimized the external factors from disguising the treatment effect. The treatment allowed easier accomplishment of the class work. The uncontrolled group selection produced similar group demographics between the control and treatment groups, except for the Age Group category. Age Group had no measurable effect on the technique variables, minimizing the effects of the control and treatment group's Age Group distribution difference. The responsibility areas were similar between the groups, except for the Logistics area The Logistics area influenced only the treatment effect for Financial Methods technique familiarity. This treatment effect was discarded.

The responses to the after-course survey were consistent for the responsibility areas. The surveys were answered thoroughly by the respondents.

The treatment had a measurable effect on some quantitative decision support technique variables. The analysis included the X^2 test, Wilcoxon Rank Sum test and the Student's t test. Errors are introduced in the X^2 test by collapsing categories to achieve the minimum acceptable expected cell value. Therefore, the X^2 test results were used as a guide and as a verification of the other test assumptions. The Student's t test is considered more accurate in detecting actual differences between samples than the Wilcoxon Rank Sum test. The rank sum test results were used to verify the Student's t text assumptions. Because the Student's t test generally agreed with the nonparametric test results, the results were used to determine effect of the treatment.

The treatment increased the technique familiarity of Statistical Analysis, Linear Programming Simulation and Project Selection. The treatment increased Statistical Analysis, Linear Programming and Financial Methods technique use frequency. The treatment increased Project Selection for computer program availability. It also increased Financial Methods for computerization benefit, computer program availability and use opportunity. Table 16 presents these effects.

The three month after-course survey did allow enough time for the treatment effects to appear.

Table 16

Observed Treatment Effects to the
Quantitative Decision Support Technique Questions

Category	Technique Question Area				
	Familiar	Use	Benefit	Available	Opportunity
Statistical Analysis	X	X			
Linear Programming	X	X			
Simulation	X				
Project Selection	X			X	
Decision Theory					
Ranking					
Networking					
Financial Methods		X	X	X	X

X means a Difference between the Control and Treatment Groups

4. What demographic characteristics effect the frequency of quantitative decision support technique use?

The Age Group and Logistics categories didn't effect the treatment effected techniques for the use frequency variable.

Logistics did have a difference for Decision Theory and Ranking. The very high and very low responsibility levels marked the Decision Theory low use frequency. The midlevels of responsibility marked Decision Theory higher. The higher the responsibility, the more use frequency with the Ranking technique.

In the product division category, Aerospace Systems Division (ASD) measured lower than the other response in Decision Theory, Ranking and Financial Methods for the technique use frequency. The other response consisted of managers assigned to test centers, Air Force major command headquarters, Ballistic Missile Systems Division, etc. This could mean that ASD's leadership doesn't emphasize decision support use as much as the other offices that participated in the survey. It might mean that the ASD manager's staff does the analysis and presents the results to the manager for the decision. This would isolate the manager from actual technique use and still use the information to make better decisions.

Those that identified themselves as program managers generally used Statistical Analysis, Linear Programming and Simulation less than those that identified as project managers or oth . The other responses included test engineer, division chief, branch chief, etc. The manager's staff might provide the information from the decision support technique analysis. Again, this would isolate the manager from actual technique use and still use the information to make better decisions.

Acquisition phase response categories and technique use were related, the earlier the phase, the more often they used the techniques. This might occur because programs in early phases f the cycle have more cost effective modification options. Those program managers whose programs are in the later stages might be reminded about the information available from decision support techniques.

Those that identified themselves as working in a SPO used the techniques less than the other category, Air Force major command headquarters, laboratories, test organizations, etc. The cause of this difference is probably similar to the causes listed for the differences for ASD.

Use is directly related with education level. Those with more formal education, doctoral degrees, use these techniques more often than those with less education. As the level of education decreases, the use decreases. The Field of Study category had no effect on the treatment. This might mean the business and management fields have increased the use of computers in their curriculum. This would have eliminated a difference from the science, engineering and math curriculums.

Computer experience and use were directly related to technique use. The more the experience and use, the more technique use there was. This could be related to the computerization of decision support techniques. Since the technique is available on a computer and the manager uses that technique, therefore the manager is more experienced with it.

The demographic characteristics that show an increase in decision support technique use allow upper management to concentrate their efforts on the areas that need attention.

ASD leaders may only need to emphasize to their system program managers that quantitative decision support techniques provide important information to the decision maker. Program managers could be reminded that the responsibility of the decision is theirs and a DSS can assist in analyzing their options. These results show the value of graduate education and computer knowledge. Both areas should continue to receive emphasis from the upper management.

5. The Defense System Management College has identified several decision support techniques that are useful to program managers. How often do program managers use decision support techniques?

For most of the techniques, the majority of the system acquisition program managers were at least moderately familiar. Very few of the managers use the techniques often. The majority believe the techniques would be useful to their decision making, if computerized. Few managers report frequent opportunities of making decisions where these techniques could be used. Many of the techniques are available on a computer.

Conclusions from the Analysis

The Intermediate Program Management (SYS-400) students were able to devote more time to learning the use of decision tree analysis information and not concentrate on rigorous computations. This study showed that program managers still do not use quantitative decision support techniques frequently in their program problem solving.

The treatment variables: technique familiarity, use frequency, computerization benefit, computer program availability and use opportunity, are all related. Managers unfamiliar with a technique will not be able to use it. They will not attempt to find a computer program that implements the technique, recognize opportunities to use the technique, or even see any potential benefit. On the other hand, managers familiar with the basics of a technique might use it often with the assistance of a computerized DSS. This would mean a higher measurement of benefit, availability and opportunity. If the subject was very familiar with a technique but is unaware of a DSS that implements it, the benefit would be high but the other variables would be low.

The data collected agreed with the above possibilities. This allows the possibility that the subjects from the treatment group observed the benefits from computerizing one technique and obtained, learned and used a DSS, even one that wasn't used in the SYS-400 class.

The techniques used for the in-class exercise were decision tree and network analysis techniques. The treatment involved only the decision tree analysis. Neither technique was effected by the treatment. The hypothesized reasons for this are: (1) the available computer programs are not satisfactory to the user (2) three months was not enough time to obtain, learn and use computerized DSSs (3) enough program problems that would benefit from decision tree or network analyses didn't occur within the three month period and (4) the subject saw the benefit for the decision tree technique and searched for, obtained and used a DSS for another.

Some of the effected techniques showed an increase in technique familiarity but not an increase in technique use. This could stem from two hypothesized reasons: (1) a technique appeared to be beneficial, therefore, the manager learned something about it and there wasn't enough time to use the newly learned technique often enough to alter their response on use frequency and (2) despite control and treatment group similarities, the treatment group was more familiar with the technique but used it as frequently as the control group.

Financial Methods showed an increase across almost all of the technique variables. This could be attributed to: (1) despite control and treatment group similarities, the treatment group was as familiar with the technique but used it more frequently than the control group and therefore knew of the benefits, availability and opportunities and (2) the combined effect of younger program managers and more responsibility in the Logistics area might mean they use Financial Methods more frequently than the other managers. The junior managers might be more familiar with Financial Methods than other techniques and rely on it heavily. This agrees with the economic rational decisional view of decision making. An external factor effect, the emphasis from Congress and other upper management on controlling program costs, has been continuous and would have effected both groups. It is unlikely that the all of the increases variables could be attributed to the treatment. The more probable reason is the treatment group was more aware and used Financial Methods more than the control group.

The two day treatment increased the use of quantitative decision support techniques. The computer program was designed to interact within the program manager's hectic pace and still provide meaningful current information. It is doubtful, but possible, that before the treatment began, the treatment group was more familiar with and used more Statistical Analysis and Linear Programming techniques.

Teaching a decision support technique with a computerized DSS does appear to increase quantitative decision support technique familiarity and use. No matter how beneficial a technique is, if it is difficult to use and implement, then those skills will just gather dust.

System acquisition midlevel program managers should attempt to obtain DSSs that complement their own decisional views. The more tools they have available, the better informed they will be. This habitually reflective thinking could assist in preventing program problems or minimizing the impact.

In order for a computerized DSS to help the manager, it should complement the manager's decisional views and fit into the manager's hectic schedule. It should provide very current information, take little time to use and provide uncertain, ad hoc, external information.

The goal of a decision support system is to take necessary, available data and transform it into a form that is meaningful to the manager. The manager is sometimes overwhelmed with reams of printouts that are not useful and often confusing. If the form isn't informative, the decision support system will not be used.

Project managers have expressed a need for certain decision support techniques to be computerized. Computers should be used to assemble data, synthesize it into information and then correlate and distribute the information.

A manager can make a better decision with more information. A good decision support system makes information available quickly and easily. Decision support systems help managers learn different techniques for problem solving. However, if the computer programs are difficult to learn or does not satisfy the office's goals, many of those gains are lost. Dangerous computerized decision errors must be prevented in order for managers to accept the decision support systems. Computer hardware compatibility is also vital.

Implications

The system acquisition manager supervisors should feel confident that courses using properly selected DSSs will increase the use of quantitative decision technique use in the program office. The additional informational from DSSs will allow the program manager to chose between alternatives.

Upper management should motivate program managers to explain the rational behind some of their major program decisions. The DSS will provide the program managers more information to explain their reasons. This supervisor attention should increase DSS use.

Despite the fact this research is not conclusive, future instructors of quantitative decision support techniques should realize the benefits of teaching with the DSS as a learning aid. It appears to increase DSS use after the student returns to their work place. A DSS selected for the course doesn't have to be the best. However, it must adhere to the guidelines outlined above to be effective. The Air Force needs to utilize as many tools as possible to make more informed decisions that effect the nation's interests.

Recommendations for Future Research

1. Identify a set of program manager demographic characteristics that could identify a group of managers for which this teaching technique might be most effective. The demographic information could be used to determine if a specific set of criteria could be found to identify the group(s) of program managers that are not affected by the

instruction treatment and the groups that are affected the most. If a set of predictors can be found, they could be used to identify the type of individual that is most likely to utilize quantitative techniques in the SPO. Those predictors could then be validated with another experiment.

This type of information could be used to develop the type of course curriculum that the program manager needs. It could identify which portions of the total program management population would benefit the most from a certain level of instruction. There are three hypothesized levels of instruction on quantitative techniques: a one or two day seminar; a two week PCE course; or several months of intense instruction such as a graduate program. No single level of instruction is best for the entire population. A regression model could possibly be used to separate the program manager population into categories. Each category could be matched to a level of instruction for the best results.

The accurate identification of the population categories would allow upper management to minimize the costs of instruction.

2. Repeat the after-course survey to the same control and treatment groups at a longer interval than three months. This would allow the managers more time to obtain, learn and use the software that is capable of supporting the types of decisions they need to make. The disadvantages are the possibility of more external variables effecting the

experiment, the subject's commander may change, more PCE classes, etc.

3. Repeat the experiment, but for a period of instruction that is longer than two class days. This would test the effectiveness of different teaching techniques. The two day course was effective but the use frequency was still low. A longer course would test for a greater treatment effect. Pretest and posttest results should be used for the comparisons. This is more rigorous and external variables are better accounted for.

4. Repeat the survey but randomly select program managers from the entire system acquisition population. This won't test the effectiveness of a teaching technique and methodology, but it will inform the researcher how often program managers, not just Air Force system acquisition midlevel managers, use quantitative decision support techniques in their program problem solving.

Appendix A: Decision Tree Computer Giude for SYS-400

Decision Tree Computer Guide
for SYS-400

This guide is to help the student become familiar with using the IBM personal computer program Supertree by Strategic Decisions Group, CA, copyrighted. This guide is intended for academic use only during the SYS-400 class. AFIT is not recommending this program to any student. The program is intended to aid in the student understanding decision tree theory and practices.

You will be provided a laptop computer with the necessary program already installed. BE CAREFUL. They are fragile.

Open the lid and adjust the screen. Plug in the computer to any wall outlet and plug the other end into the small female plug on the right edge of the back of the computer. It is marked 'DC'. Turn on the computer, the switch is on the right side of the computer towards the back.

After the computer starts up, you will see a menu. On the right side of the menu you will see 'F2 SYS-400'. Press the 'F2' key at the top of your keyboard. On the left side of the menu you will see '1 Supertree'. Select Supertree by pressing the 'Enter' key or the number '1' near the top of the keyboard.

When Supertree starts you will see this screen: (screens are separated from the text by shaded lines)

```
Structure Evaluate Analyze Utility Programs Files Quit
Input, Show, Delete, Renumber, Treename, Clear
--------------------------STUDENT EDITION--------------------------



                    SUPERTREE, VERSION 5.25
               c STRATEGIC DECISIONS GROUP, 1986



Esc to discard input or move to higher menu
PgUp to view previous screens
Ctrl PrtSc to use printer
```

These commands are important. Take the time to find these keys and the arrow keys. If a command lists two keys, hold down the first then press the second. The first row of words are the menu choices. The second row is the menu available from the highlighted choice or a short explanation of the selection. To select from the menu, highlight the desired choice by moving the highlight bar with the right and left arrow keys. Or you can press the first letter of the desired choice. The highlight bar is displayed in this text as underlines.

Press the right arrow key three times to 'Utility' and then press 'Enter' or just press 'U'. Select 'Configuration' and the following screen will appear. Everything should be setup for you already. You may want to change the 'Decision criterion:' to 'MAXIMIZE' or 'MINIMIZE' depending if the model is used to maximize profits or minimize costs.

```
                              CONFIGURATION
            Use F1 to input screen data; Esc to discard screen data.
------------------------------STUDENT EDITION-------------------------------

Decision criterion:
    Maximize or minimize expected value/certain equivalent? MINIMIZE
Numerical formats (field width, decimal places):
    Format for values? 8 0
    Format for probabilities? 4 2
Interval at which running total of models run is shown? 25
Use line graphics? YES
Default drive for Supertree (files, models, worksheets, etc.)? C
Drive on which to find system for Lotus, Symphony, IFPS, FCS or Multiplan? C
Drive for configuration file, SUPERT.CNF? C
Color combination used on screen (7=B&W)? 7
Which port is printer attached to? LPT1
Maximum column width of printer: 144
Printer setup message: 15
```

The printer setup message sets the printer to condensed print (17cpi). If you want to change to 10 cpi, delete the 15 and change the maximum column width to 80.

After you have made all of the changes you want, press 'F1'. If you made mistakes and want to start over, press 'Esc'. You can move up and down the input screen with the arrow keys. As you enter information in any of the input screens, the old information is erased in that field when you press your first key. If the field has only a few choices, only the first one or two letters are required. The program will supply the rest. For example, if you wanted to change 'Decision criterion:' from 'MINIMIZE' to 'MAXIMIZE' (as you would need to do for the Decision Tree Bidding example), you would only have to type 'MA' and press 'Enter'. Supertree will fill in the rest. 'Y' is enough for an answer to a yes/no question. Supertree capitalizes all of your inputs automatically. If you can not get capitalized letters, press the 'Num Lock' key. If this doesn't work, ask for assistance.

Be sure to periodically save your work

Structure Evaluate Analyze Utility Programs Files Quit
Savefile, Recallfile, Wscopy, Directory
——————————STUDENT EDITION——————————

Savefile Recallfile Wscopy Directory
Save structure and values of a tree to a file
——————————STUDENT EDITION——————————
Name under which to save file.

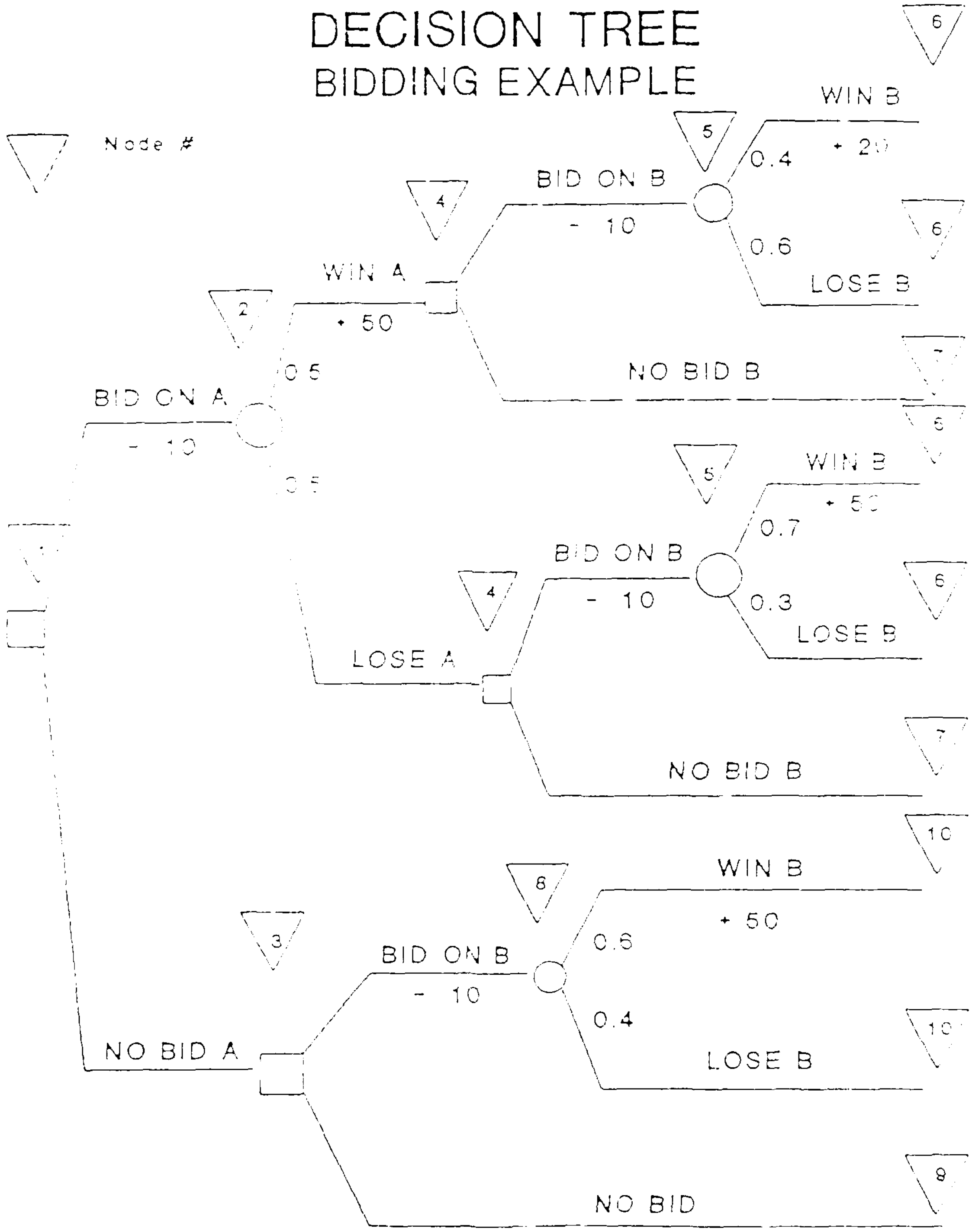
Savefile Recallfile Wscopy Directory
Recall structure and values of a tree from a file
——————————STUDENT EDITION——————————
Name of drive: C
Files:

BIDEX
Name of file to be recalled: __________

After you have drawn out your tree manually, you will want to enter it into Supertree. To create a new tree, press 'Esc' until the main menu appears. Select 'Structure'. Select 'Input'. The following screen will appear. Answer the screen prompts. On your manually drawn tree number the different nodes. Normally, nodes are numbered starting from '1' and increase to the right. This is not mandatory for this program but it will help you keep track of which branch goes where. For this program, nodes are only different when the previous decision types and states of nature are not the same.

The example shown in class is repeated here to demonstrate some features of the program. (See the Decision Tree Bidding Example figure on page 4)

DECISION TREE
BIDDING EXAMPLE



FIGURES ARE VALUES IN THOUSANDS

Enter a unique number for Number of node (positive)
Node type can be CHANCE, DECISION or ENDPOINT (C,D or E)
Number of branches is the number of choices/possibilities available from that node

This first screen shows the error message when you try to enter an incorrect node type.

```
Input Show Delete Renumber Treename Clear
Add or change node input
POSSIBLE RESPONSES ARE:  DECISION CHANCE ENDPOINT────────────────────

Number of node: 9
Node type: S
```

```
Input Show Delete Renumber Treename Clear
Add or change node input
──────────────────────STUDENT EDITION───────────────────────
Enter a descriptive name for this tree. BIDDING TREE
Number of node: 1
Node type: DECISION
Number of branches: 2
```

Enter a short, unique and descriptive name, such as BIDA.

```
                     DECISION/CHANCE NODE ENTRY
          Use F1 to input screen data; Esc to discard screen data.
─────────────────────────────────────────────────────────────────
                          NODE NUMBER:1

TYPE:DECISION                 OUTCOMES DEPEND ON NODES:

NUMBER OF BRANCHES:2
NODE NAME: ____________
                                         SUCCESSOR
       OUTCOME          REWARD           NODE

     ┌──0──────────────0──────  ─────────0──
     D
     └──0──────────────0──────────────────0──
```

Use only letters and numbers for the node name. The program will tell you if you used illegal characters.

```
                          DECISION/CHANCE NODE ENTRY
               Use F1 to input screen data; Esc to discard screen data.
FIRST CHARACTER MUST BE A LETTER, REST LETTERS OR NUMBERS, NO BLANKS————————
                          NODE NUMBER:1

TYPE:DECISION                    OUTCOMES DEPEND ON NODES:
NUMBER OF BRANCHES:2
NODE NAME:BID A
```

Enter the results of the decision or state of nature under 'OUTCOME'. Use the arrow keys to edit the inputs. When finished, press 'F1'.

```
                          DECISION/CHANCE NODE ENTRY
               Use F1 to input screen data; Esc to discard screen data.
————————————————————————————STUDENT EDITION——————————————————————————————
                          NODE NUMBER:1

TYPE:DECISION                    OUTCOMES DEPEND ON NODES:
NUMBER OF BRANCHES:2
NODE NAME:BIDA
                                          SUCCESSOR
          OUTCOME          REWARD         NODE

       ┌──10──────────────0──────────────2──
       D
       └──0───────────────0──────────────3
```

Select 'Input' to enter the next node.

```
                     DECISION/CHANCE NODE ENTRY
          Use F1 to input screen data; Esc to discard screen data.
--------------------------------STUDENT EDITION--------------------------------
                         NODE NUMBER:2

TYPE CHANCE                         OUTCOMES DEPEND ON NODES:
NUMBER OF BRANCHES:2                PROBABILITIES DEPEND ON NODES:
NODE NAME WINA
                                                        SUCCESSOR
          PROBABILITY    OUTCOME         REWARD         NODE

       ┌--.5-------------50--------------0--------------4--
       C
       └--.5-------------0---------------0--------------4--
```

```
                     DECISION/CHANCE NODE ENTRY
          Use F1 to input screen data; Esc to discard screen data.
--------------------------------STUDENT EDITION--------------------------------
                         NODE NUMBER:4

TYPE:DECISION                       OUTCOMES DEPEND ON NODES:
NUMBER OF BRANCHES:2
NODE NAME:BIDAB
                                         SUCCESSOR
          OUTCOME         REWARD         NODE

       ┌--10-------------0--------------5--
       D
       └--0--------------0--------------7
```

If the outcome or probabilities are dependent on a chain of previous node(s), enter those node numbers in the spaces on the top right of the entry screen. Thus, when we get to node 5, both the probabilities and the outcomes depends on what happens at node 2.

```
                         DECISION/CHANCE NODE ENTRY
           Use F1 to input screen data; Esc to discard screen data.
-------------------------------------------------------------------------------
                            NODE NUMBER:5

TYPE:CHANCE                    OUTCOMES DEPEND ON NODES:2
NUMBER OF BRANCHES 2           PROBABILITIES DEPEND ON NODES:2
NODE NAME:BIDAWINB
          SELECT TO       SELECT TO                     SUCCESSOR
         ENTER/REVIEW    ENTER/REVIEW    REWARD         NODE
         PROBABILITIES    OUTCOMES
       ┌──────────────────────────────0──────────────0──
       C
       └──────────────────────────────0──────────────0──
```

Select the probabilities field. The next screen appears. On the left side is the output of the nodes that this node depends. On the right is where you enter/review the specific probabilities or outputs. To step through each possible combination, use the 'Tab' key.

```
             Use Tab/Shift Tab To Scroll Through Conditioning Nodes.
        Use F1 to Return to Node Entry Screen; Shift PrtSc to Print Screen.
--------------------------------STUDENT EDITION--------------------------------

 WINA                    PROBABILITY FOR BIDAWINB
 ----
>50                     ┌─.4──────────
 0                      C
                        └─.6
```

8

Use Tab/Shift Tab To Scroll Through Conditioning Nodes.
Use F1 to Return to Node Entry Screen, Shift PrtSc to Print Screen.

STUDENT EDITION

```
WINA          PROBABILITY FOR BIDAWINB
----
50             ┌─.7──────────
>0             C
               └─.3
```

Next, enter the correct outcomes for each situation.

Use Tab/Shift Tab To Scroll Through Conditioning Nodes.
Use F1 to Return to Node Entry Screen; Shift PrtSc to Print Screen.

STUDENT EDITION

```
WINA       OUTCOME FOR BIDAWINB
----
>50         ┌─20──────────
0           C
            └─0───────────
```

Use Tab/Shift Tab To Scroll Through Conditioning Nodes.
Use F1 to Return to Node Entry Screen; Shift PrtSc to Print Screen.

STUDENT EDITION

```
WINA       OUTCOME FOR BIDAWINB
----
50          ┌─50──────────
>0          C
            └─0───────────
```

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For the Bidding Tree example, when NODE 5 is complete, this is what your inputs should look like.

```
                            DECISION/CHANCE NODE ENTRY
          Use F1 to input screen data; Esc to discard screen data.
---------------------------------STUDENT EDITION---------------------------------
                        NODE NUMBER:5

TYPE:CHANCE                          OUTCOMES DEPEND ON NODES:2
NUMBER OF BRANCHES:2                 PROBABILITIES DEPEND ON NODES:2
NODE NAME:BIDAWINB
          SELECT TO       SELECT TO                        SUCCESSOR
         ENTER/REVIEW    ENTER/REVIEW    REWARD            NODE
         PROBABILITIES    OUTCOMES
      ┌─────────────────────────────────0──────────────6──
      C
      └─────────────────────────────────0──────────────6──
```

To review what you have entered, sel^ct 'Show'. The following screen will appear. If it scrolls off the screen, press the 'PgUp', 'PgDn' or the arrow keys to see what you want. The key to the output under the heading 'STRUCTURE' is: NODE #, NODE TYPE, and SUCCESSOR NODES.

```
Input Show Delete Renumber Treename Clear
Show the structure entered for the tree
---------------------------------STUDENT EDITION---------------------------------
Tree name: BIDDING TREE

 STRUCTURE  NAMES       OUTCOMES        PROBABILITIES

 1 D 2 3    BIDA        -10 0
 2 C 4 4    WINA        50 0            .5 .5
 4 D 5 7    BIDAB       -10 0
 5 C 6 6    BIDAWINB    Depends on 2    Depends on 2

  WINA  OUTCOME, NODE 5
C-50--  20 0
└-0---  50 0

  WINA  PROBABILITY, NODE 5
C-50--  0.4 0.6
└-0---  0.7 0.3

>> TREE CONTAINS SUCCESSORS WHICH ARE NOT DEFINED AS NODES
```

To correct the information in a node, select 'Input' to get the node entry screen. Use the arrow keys to select the desired field and enter the correct information. There is no means of editing the field's entry. The entire field must be retyped. If node 4's 1st branch outcome was entered as '10', the correcting entry would be '-10'. The minus sign can't be just inserted.

At the end of the tree we have 'ENDPOINT's. Supertree can calculate the values of the endpoints in our example as follows. To enter endpoints that can have variable values, a formula must be entered The formula must start with 'B$' to let the program know a formula, not a variable name of this node, follows. The formula is then entered, parenthesizes are optional. The following screen shows summing the values of the nodes that led to this endpoint. The node names are the variable names. The node numbers are then entered on the next line.

```
                              ENDPOINT ENTRY
          Use F1 to input screen data; Esc to discard screen data.
-------------------------------STUDENT EDITION--------------------------------
                              NODE NUMBER:6

TYPE: ENDPOINT

Name/value of endpoint:
  B$(BIDA+WINA+BIDAB+BIDAWINB)

Nodes upon which endpoint depends:
  1 2 4 5
```

Be sure to periodically save your work.

```
Structure Evaluate Analyze Utility Programs Files Quit
Savefile, Recallfile, Wscopy, Directory
-------------------------------STUDENT EDITION--------------------------------
```

```
Savefile Recallfile Wscopy Directory
Save structure and values of a tree to a file
-------------------------------STUDENT EDITION--------------------------------
Name under which to save file:C:BIDEX
```

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Here is the structure of the complete tree.

```
Tree name: BIDDING TREE

STRUCTURE   NAMES                  OUTCOMES              PROBABILITIES

1 D 2 3     BIDA                   -10 0
2 C 4 4     WINA                   50 0                  .5 .5
3 D 8 9     NOABIDB                -10 0
4 D 5 7     BIDAB                  -10 0
5 C 6 6     BIDAWINB               Depends on 2          Depends on 2
6 E         B$(BIDA+WINA+BIDA&     Depends on 1 2 4 5
            B+BIDAWINB)
7 E         B$(BIDA+WINA+BIDA&     Depends on 1 2 4
            B)
8 C 10 10   NOAWINB                50 0                  .6 .4
9 E         B$(BIDA+NOABIDB)       Depends on 1 3
10 E        B$(BIDA+NOABIDB+N&     Depends on 1 3 8
            OAWINB)


  WINA  OUTCOME, NODE 5
C-50—   20 0
└-0——   50 0

  WINA  PROBABILITY, NODE 5
C-50—   0.4 0.6
└-0——   0.7 0.3
```

Press 'Esc' to backup to the main menu. Select 'Evaluate'. You need to evaluate the tree anytime the node inputs are changed.

```
Structure Evaluate Analyze Utility Programs Files Quit
Calculate branch values using the endpoint models/values
——————————————————————STUDENT EDITION——————————————————————
Supertree will check input compatibility and will then evaluate endpoints;
   this may take some time.
Do you wish to continue with this evaluation? YES
>> TOTAL OF 9 MODELS RUN
>> ENDPOINT VALUES ASSIGNED                         BIDDING TREE
```

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Select 'Analyze' to get to the 'Analyze' submenu.

```
Structure Evaluate Analyze Utility Programs Files Quit
Rollback, Display, Plot, List, Sensitivity, Attitude-to-Risk, Trace
-----------------------------STUDENT EDITION-----------------------------
```

Select 'Display' to show the tree drawn.

```
Rollback Display Plot List Sensitivity Trace Attitude-to-Risk
Show portions of evaluated tree
-----------------------------STUDENT EDITION-----------------------------
```

If you want the order of the nodes to remain the same, just press 'Enter'.

```
                                   DISPLAY
           Use F1 to input screen data; Esc to discard screen data.
-----------------------------STUDENT EDITION-----------------------------
Present Order of Nodes:
  1 2 4 5 3 8
New Order of Nodes:
  1 2 4 5 3 8

First Node: 1
Last Node: 8

Single or double spacing? SINGLE
```

The output to the screen will look like the screen below. If you want to print the tree also, press 'Ctrl PrtSc'. 'PRINTER' will appear on the right edge of the screen just below the menus. Use the arrow (cursor) keys to view parts of the tree that are off the screen, if any. To print the entire screen, press 'Shift PrtSc'.

```
Use Cursor/Shift Cursor keys to scroll off screen; Esc to return to main menu.

------------------------------------STUDENT EDITION------------------------PRINTER
  BIDA    EXP VAL    PROB  WINA  EXP VAL   BIDAB    EXP VAL   PROB BIDAWINB  EXP VAL
  ----    -------    ----  ----  -------   -----    -------   -------------  -------
                                          ┌─10──────────38─C─0.40─20──────────50─
                      ┌─0.50─50──────40─D                   └─0.60─0───────────30─
┌>-10───────────28─C                     └>0─────────────40──────────────────────
│                     │                   ┌>-10─────────15─C─0.70─50──────────30─
D                     └─0.50─0───────15─D                   └─0.30─0───────────20─
│                                         └─0────────────10──────────────────────
│                                                                               ┌
└─0─────────────20──────────────────────────────────────────────────────────────D
                                                                                └
```

Press 'Shift -->' to see the rest of the tree.

```
Use Cursor/Shift Cursor keys to scroll off screen; Esc to return to main menu.

------------------------------------STUDENT EDITION-  ---------------------PRINTER
  BIDAB    EXP VAL  PROB BIDAWINB EXP VAL  NOABIDB   EXP VAL PROB NOAWINB EXP VAL
  -----    -------  ------------- -------  -------   ------- ------------ -------
┌─10──────────38─C─0.40─20──────────50──────────────────────────────────────────
D                 └─0.60─0──────────30──────────────────────────────────────────
└>0────────────40───────────────────────────────────────────────────────────────
┌>-10─────────15─C─0.70─50──────────30──────────────────────────────────────────
D                 └─0.30─0──────────20──────────────────────────────────────────
└─0────────────10───────────────────────────────────────────────────────────────
                                          ┌>-10──────────20─C─0.60─50────────40
──────────────────────────────────────────D                  └─0.40─0─────────10
                                          └─0─────────────0────────────────────
```

This is what the printed output looks like with 80 columns.

```
 BIDA    EXP VAL    PROB WINA  EXP VAL    BIDAB    EXP VAL    PROB BIDAWINB  EXP VAL
 ____    _______    ____ ____  _______    _____    _______    ____ ________  _______
                                         ┌─10───────────38─C─0.40─20───────────50──
                     ┌─0.50─50──────40─D                   └─0.60─0────────────30──
┌>-10─────────28─C                       └>0────────────40──────────────────────────
│                    │                   ┌>-10──────────15─C─0.70─50───────────30──
D                    └─0.50─0───────15─D                   └─0.30─0────────────20──
│                                        └─0────────────10──────────────────────────
│
└─0───────────20────────────────────────────────────────────────────────────────────

 NOABIDB   EXP VAL    PROB NOAWINB EXP VAL
 _______   _______    ____ _______ _______
 _________________________________________
 _________________________________________
 _________________________________________
 _________________________________________
 _________________________________________
 _________________________________________
┌>-10──────────20─C─0.60─50──────────40─
D                 └─0.40─0───────────10─
└─0─────────────0───────────────────────
```

```
>> Tree Drawn                        BIDDING TREE
>> Expected Value: 28
```

Change the order of nodes, if necessary, to display only the parts of the tree you want. Enter the nodes wanted in the desired order, press 'Enter' and the program will fill in the rest of the nodes. Then enter the first node to be displayed and the last node to be displayed.

```
Present Order of Nodes:

  1 2 4 5 3 8
New Order of Nodes:
  1 3 8 2 4 5

First Node: 1
Last Node: 8

Single or double spacing? SINGLE


  BIDA    EXP VAL   NOABIDB   EXP VAL    PROB  NOAWINB  EXP VAL
  ____    _______   _______   _______    ____  _______  _______
┌>-10 ──────────28─────────────────────────────────────────────
D                 ┌>-10 ──────────20─C─0.60─50──────────40─
└─0 ────────────20─D                   └─0.40─0───────────10─
                  └─0 ─────────────0────────────────────────

>> Tree Drawn                           BIDDING TREE
>> Expected Value: 28
```

If you want to analyze the tree's sensitivity to changes in a probability distribution at a node, select 'Sensitivity'. Sensitivity to risk tolerance is also available.

```
Rollback Display Plot List Sensitivity Trace Attitude-to-Risk
Perform sensitivity analysis on probabilities or risk tolerance
──────────────────────────────────STUDENT EDITION──────────────────────────────────
```

```
Probability Risk
Perform sensitivity to variations in probability at a node
──────────────────────────────────STUDENT EDITION──────────────────────────────────
```

Probability Risk
Perform sensitivity to variation in the risk tolerance
———————————STUDENT EDITION———————————

PROBABILITY SENSITIVITY
Use F1 to enter screen data; Esc to discard screen data.
———————————STUDENT EDITION———————————

Present Order of Nodes:
1 2 4 5 3 8
New Order of Nodes:
1 2 4 5 3 8

For which node do you want the sensitivity to probability? 2
Small or large sized plot? SMALL

Because the sensitivity requires multiple tree evaluations,
it may take some time to run.
Smallest and largest values encountered are: 15 40
Lower and upper limits for vertical axis: 10 45

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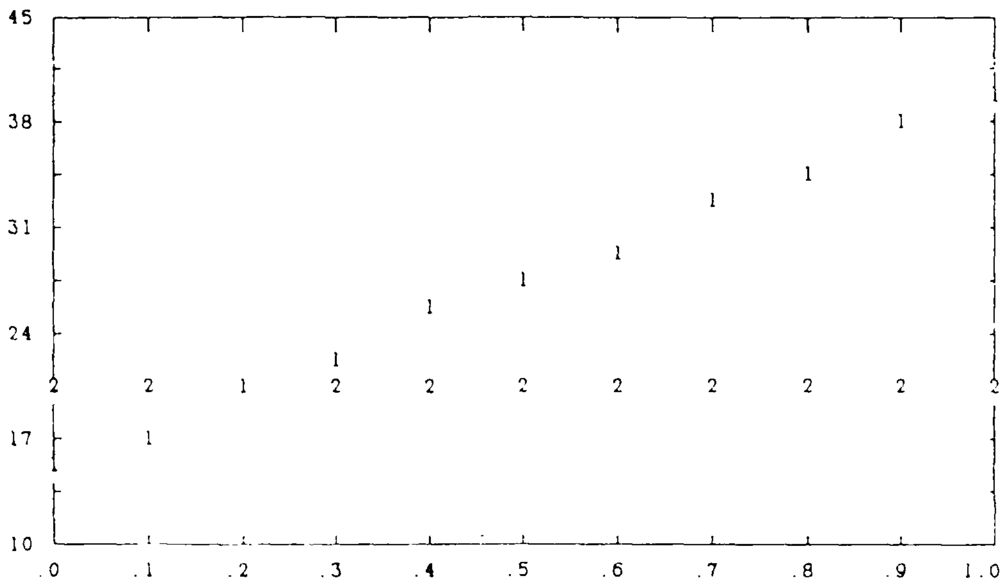
If the first node is a decision, the sensitivity will be shown for all branches.
The vertical axis is the expected value.
The horizontal axis is the probability of the first branch of node 2;
the last branch of node 2 has the remainder of the probability.

>> Probability Sensitivity BIDDING TREE



'PgUp' to view previous screens

Probability Risk
Perform sensitivity to variation in the risk tolerance
STUDENT EDITION

Present Order of Nodes:

1 2 4 5 3 8
New Order of Nodes:
1 2 4 5 3 8

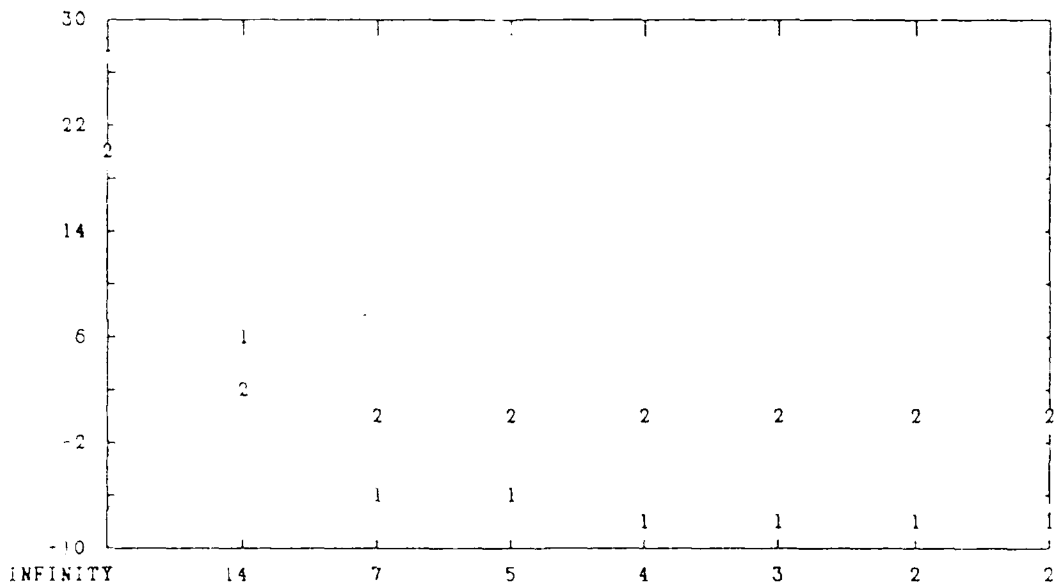
Vary risk tolerance from infinity down to? 2
Small or large sized plot? SMALL

18

Because the sensitivity requires multiple tree evaluations,
the program may take some time to run.
Smallest and largest certain equivalents are -9 28
Lower and upper limits to be used for plot: -10 30

If the first node is a decision, the sensitivity is shown for all branches.
The vertical axis is the certain equivalent.
The horizontal axis is the risk tolerance;
the scale is linear in 1/risk tolerance.

>> Risk Sensitivity BIDDING TREE



Rollback Display Plot List Sensitivity Trace <u>Attitude-to-Risk</u>
Set the risk tolerance to be used in tree analysis
——————————STUDENT EDITION——————————

Do you wish to use the exponential utility function? YES
Input the value for the Risk Tolerance: ________

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Be sure to periodically save your work.

Structure Evaluate Analyze Utility Programs Files Quit
Savefile, Recallfile, Wscopy, Directory
————————————STUDENT EDITION————————————

To exit the program, press 'Esc' to get to the main menu. Select 'Quit'.

Structure Evaluate Analyze Utility Programs Files Quit
Quit Supertree
————————————STUDENT EDITION————————————

No Yes
Return to Main Supertree Menu
————————————STUDENT EDITION————————————

No Yes
Quit Supertree Now (Have You Saved Your Work?)
————————————STUDENT EDITION————————————

Quick Reference of Important Commands

'Esc' to discard input or move to higher menu
'PgUp' to view previous screens
'Ctrl PrtSc' to use printer (on and off)
'Shift PrtSc' to print entire screen
Use Right/Left arrow keys to highlight menu choices and press 'Enter' to select
OR Select menu choices by pressing the first letter of that choice
All formulas must start with 'B$' when the tree is not linked to other programs

Appendix B: SYS-400 After-Course Survey

DEPARTMENT OF THE AIR FORCE
AIR UNIVERSITY
AIR FORCE INSTITUTE OF TECHNOLOGY
WRIGHT-PATTERSON AIR FORCE BASE OH 45433-6583

REPLY TO ATTN OF: LSY (Capt Donahue, AV 785-3355) 13 FEB 89

SUBJECT: SYS-400 After Course Survey

TO: Maj John Q. Doe III

1. A survey of recent SYS-400 graduates is being taken to gather information about decision making. Your responses to this survey will help us improve the tools available for managers to effectively manage their programs.

2. Please take the time to complete the attached survey and return it by 19 JUN 89. The information collected will serve as the basis for an AFIT graduate student thesis on the use of computers as an aid in program management decision making. All participants in this survey will remain anonymous and participation is voluntary.

3. Thank you for your support in this research effort. Should you require further information, please contact me at AV 785-3355. If you are interested in receiving a summary of the results of this research, please write to:

AFIT/LSG
ATTN: Capt Mark Donahue
Wright-Patterson AFB, OH 45433-6583

EDWARD J. ROWLAND, Lt Col, USAF
SYS-400 Course Director
AFIT School of Systems and Logistics

STRENGTH THROUGH KNOWLEDGE

SURVEY FOR SYS-400

Do NOT put your name or SSN on the answer sheet or questionnaire. This information is strictly anonymous. No identification required.

For each question, select the answer most appropriate for you. Please mark all your responses on the answer sheet with a No. 2 pencil and completely blacken the circle. Include BOTH the answer sheet and the questionnaire in the return envelope.

1. For which product division do you work?

   1. ELECTRONIC SYSTEMS DIVISION
   2. AERONAUTICAL SYSTEMS DIVISION
   3. SPACE DIVISION
   4. OTHER (Specify) ______

2. What is your rank?

   1. CAPTAIN OR BELOW
   2. MAJOR
   3. LIEUTENANT COLONEL OR ABOVE
   4. GM-12, GS-12 OR BELOW
   5. GM-13, GS-13 OR ABOVE

3. What is the highest academic degree you hold?

   1. BACHELORS DEGREE
   2. MASTERS DEGREE
   3. DOCTORATE DEGREE
   4. NONE OF THE ABOVE

4. In what field is/are your degree(s) (mark all that apply)?

   1. ENGINEERING
   2. SCIENCE AND/OR MATH
   3. BUSINESS AND/OR MANAGEMENT
   4. OTHER (Specify) ______

5. How would you classify the SPO in which you work?

   1. BASKET SPO (more than one weapon system)
   2. SINGLE SYSTEM SPO
   3. OTHER (Specify) ______

6. I am a:

   1. SPO DIRECTOR (Chief of an entire SPO)
   2. PROGRAM MANAGER (Single Manager of a complete system - works for the SPO director)
   3. PROJECT MANAGER (Manager of a program's system subcomponent - works for a Program manager)
   4. OTHER (Specify) ______

7. How much cumulative experience do you have as a government program or project manager (in whole years, at one half, round up)?

   1. NONE
   2. 1
   3. 2 - 3
   4. 4 - 6
   5. MORE THAN 6

8. Please mark your age group?

   1. UNDER 30 YEARS OLD
   2. 30 - 35 YEARS OLD
   3. 36 - 40 YEARS OLD
   4. 41 - 45 YEARS OLD
   5. OVER 45 YEARS OLD

9. What is the current phase of your program(s)? (Mark more than one response if you have programs in different phases.)

   1. CONCEPT EXPLORATION
   2. DEMONSTRATION/VALIDATION
   3. FULL SCALE DEVELOPMENT
   4. PRODUCTION AND DEPLOYMENT

10. How familiar are you with using a personal computer or a mainframe computer?

    1. NONE
    2. SLIGHTLY
    3. MODERATELY
    4. VERY
    5. COMPLETELY

11. How often do you personally use a computer for your work?

    1. NEVER
    2. LESS THAN 1 HOUR A DAY
    3. 1 to 2 HOURS A DAY
    4. 3 to 4 HOURS A DAY
    5. MORE THAN 4 HOURS A DAY

For the following questions, mark the appropriate answer based on the following scale of answers:

1	2	3	4	5
NEVER	RARELY	SOMETIMES	FREQUENTLY	ALWAYS

I make/have made program/project decisions related to:

12.	cost and budget	1	2	3	4	5
13.	schedule	1	2	3	4	5
14.	technical performance	1	2	3	4	5
15.	logistics	1	2	3	4	5
16.	administration of program personnel	1	2	3	4	5
17.	establishing spares levels and deciding other spares associated issues	1	2	3	4	5
18.	establishing prototype or production schedules	1	2	3	4	5
19.	selection of SPO personnel	1	2	3	4	5
20.	Program Objective Memorandum inputs	1	2	3	4	5
21.	establishing the contents of the Integrated Logistics Support Plan	1	2	3	4	5
22.	approval of Engineering Change Proposals	1	2	3	4	5
23.	selection of reliability criteria	1	2	3	4	5
24.	designation of job responsibilities for other SPO personnel	1	2	3	4	5
25.	setting of specification requirements	1	2	3	4	5
26.	establishing major milestone dates	1	2	3	4	5
27.	supplying gov't furnished equipment versus contracting for the equipment	1	2	3	4	5
28.	setting dates for major reviews	1	2	3	4	5
29.	redirecting contractor technical effort	1	2	3	4	5
30.	types of procurement data purchased	1	2	3	4	5
31.	system cost estimates	1	2	3	4	5

A list of quantitative technique categories, which may have been valuable to you as a program or project manager, is on the next several pages. Answer the following five questions for each category.

QUESTIONS

Familiar - Indicate how familiar you are with the one or more of the techniques in each category.

Use - For each category, indicate how often you (not others) now use or have used one or more of these techniques for program management.

Benefit - In each category, how often could one or more of these techniques be helpful to you in making decisions in your program?

Available - For all of the techniques in each category, what proportion are available with the aid of a personal computer or mainframe computer?

Opportunity - Disregarding time limitations, how often do you make decisions where one or more of these techniques could have been used?

Statistical Analysis - the collection, organization and interpretation of data according to well defined statistical procedures. Includes sampling, averages, regression, and time series analysis.

		1	2	3	4	5
32.	Familiar	NONE	SLIGHTLY	MODERATELY	VERY	COMPLETELY
33.	Use	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
34.	Benefit	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
35.	Available	NONE	SOME	HALF	MOST	ALL
36.	Opportunity	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS

Linear programming and other math programming methods - a group of techniques for optimizing the use of limited resources. Includes integer programming, nonlinear programming, and dynamic programming.

		1	2	3	4	5
37.	Familiar	NONE	SLIGHTLY	MODERATELY	VERY	COMPLETELY
38.	Use	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
39.	Benefit	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
40.	Available	NONE	SOME	HALF	MOST	ALL
41.	Opportunity	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS

Simulation - a computerized mathematical-logical model of a real system or situation. Experimentation with the simulation aids in decisions surrounding the system or situation. Includes reliability analysis.

		1	2	3	4	5
42.	Familiar	NONE	SLIGHTLY	MODERATELY	VERY	COMPLETELY
43.	Use	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
45.	Benefit	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
46.	Available	NONE	SOME	HALF	MOST	ALL
47.	Opportunity	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS

Project selection models - this includes models developed for aiding in the selection of Research and Development projects. Includes the Mottley-Newton model, Disman model, goal programming and Delphi techniques.

		1	2	3	4	5
48.	Familiar	NONE	SLIGHTLY	MODERATELY	VERY	COMPLETELY
49.	Use	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
50.	Benefit	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
51.	Available	NONE	SOME	HALF	MOST	ALL
52.	Opportunity	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS

Decision theory - a systematic technique for quantifying complex decisions and analyzing alternatives. Includes the use of decision trees, influence diagrams or payoff tables. Also includes utility theory, risk analysis and game theory.

		1	2	3	4	5
53.	Familiar	NONE	SLIGHTLY	MODERATELY	VERY	COMPLETELY
54.	Use	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
55.	Benefit	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
56.	Available	NONE	SOME	HALF	MOST	ALL
57.	Opportunity	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS

Ranking - a technique of putting factors related to decisions in a ranked order of importance based on a survey of knowledgeable individuals. Includes index numbers, checklists and Analytical Hierarchy Process.

		1	2	3	4	5
58.	Familiar	NONE	SLIGHTLY	MODERATELY	VERY	COMPLETELY
59.	Use	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
60	Benefit	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
61.	Available	NONE	SOME	HALF	MOST	ALL
62.	Opportunity	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS

Networking - a graphical description of a problem or situation consisting of discrete activities related to time and to each other. Includes PERT, CPM, Gantt charts and milestone charts.

		1	2	3	4	5
63.	Familiar	NONE	SLIGHTLY	MODERATELY	VERY	COMPLETELY
64.	Use	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
65.	Benefit	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
66.	Available	NONE	SOME	HALF	MOST	ALL
67.	Opportunity	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS

Financial methods - this includes a group of financial evaluation techniques including equivalent uniform annual cost, present value, internal rate of return, net present value, payback period, financial percent return on investment, cost-benefit analysis, C/SCSC, PPBS and Life Cycle Cost.

		1	2	3	4	5
68.	Familiar	NONE	SLIGHTLY	MODERATELY	VERY	COMPLETELY
69.	Use	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
70.	Benefit	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
71.	Available	NONE	SOME	HALF	MOST	ALL
72.	Opportunity	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS

Other - Specify below (Leave answer sheet BLANK if NOT used)

		1	2	3	4	5
73.	Familiar	NONE	SLIGHTLY	MODERATELY	VERY	COMPLETELY
74.	Use	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
75.	Benefit	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
76.	Available	NONE	SOME	HALF	MOST	ALL
77.	Opportunity	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS

Other - Specify below (Leave answer sheet BLANK if NOT used)

		1	2	3	4	5
78.	Familiar	NONE	SLIGHTLY	MODERATELY	VERY	COMPLETELY
79.	Use	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
80.	Benefit	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS
81.	Available	NONE	SOME	HALF	MOST	ALL
82.	Opportunity	NEVER	SELDOM	OCCASIONALLY	OFTEN	ALWAYS

If you have any comments concerning the use of computers as an aid to decision making for program managers or anything else, please include them in the space below.

Comments:

Include BOTH this survey and the answer sheet in the return envelope.

Thank you for your time and cooperation.

Appendix C: Wilcoxon Rank Sum Test Results of Comparison between Control and Treatment Groups' Demographics

Question	Wilcoxon T	Probability
1. Product Division	0.149	0.8816
2. Rank	1.165	0.2439
3. Highest Degree	0.160	0.8732
4. Field of Study	0.790	0.4295
5. SPO Type	0.468	0.6396
6. Job Position	0.968	0.3328
7. Cumulative Experience	0.963	0.3355
8. Age Group	1.958	0.0502
9. Acquisition Phase	1.340	0.1802
10. Computer Familiarity	0.521	0.6020
11. Computer Use	0.591	0.5547

Appendix D: X^2 Test Results of Comparison between Control and Treatment Groups' Responsibility Areas

Main Area

Question	X^2	df	Probability
12. Cost and Budget	1.990	2	0.370
13. Schedule	3.513	2	0.173
14. Technical Performance	0.267	2	0.875
15. Logistics	4.054	2	0.132
16. Admin of Pgm Personnel	2.166	4	0.705

Specific Area

Question	X^2	df	Probability
20. Cost and Budget	1.835	3	0.607
27. Cost and Budget	8.448	4	0.076
31. Cost and Budget	7.169	3	0.067
18. Schedule	4.006	3	0.261
26. Schedule	3.228	2	0.199
28. Schedule	3.786	4	0.436
22. Technical Performance	1.746	4	0.782
25. Technical Performance	1.124	4	0.890
29. Technical Performance	9.883	4	0.042
17. Logistics	3.141	2	0.2[illegible]
21. Logistics	5.096	2	0.078
23. Logistics	5.258	2	0.072
30. Logistics	10.602	4	0.031
19. Admin of Pgm Personnel	0.525	3	0.913
24. Admin of Pgm Personnel	3.040	4	0.551

Appendix E: Wilcoxon Rank Sum Test Results of Comparison between Control and Treatment Groups' Responsibility Areas

Main Area

Question	Wilcoxon T	Probability
12. Cost and Budget	1.314	0.1887
13. Schedule	0.341	0.7334
14. Technical Performance	0.154	0.8774
15. Logistics	1.898	0.0577
16. Admin of Pgm Personnel	1.117	0.2638

Specific Area

Question	Wilcoxon T	Probability
20. Cost and Budget	0.676	0.4992
27. Cost and Budget	1.618	0.1057
31. Cost and Budget	1.564	0.1177
18. Schedule	1.277	0.2016
26. Schedule	0.027	0.9784
28. Schedule	1.655	0.0979
22. Technical Performance	0.266	0.7902
25. Technical Performance	0.293	0.7698
29. Technical Performance	2.160	0.0307
17. Logistics	1.362	0.1731
21. Logistics	2.091	0.0365
23. Logistics	1.591	0.1116
30. Logistics	2.208	0.0272
19. Admin of Pgm Personnel	0.218	0.8273
24. Admin of Pgm Personnel	0.458	0.6472

Appendix F: X^2 Test Results of Comparison between Control and Treatment Groups' Quantitative Decision Support Technique Responses

Statistical Analysis Category

Question	X^2	df	Probability
32. Familiar	7.528	2	0.023
33. Use	5.898	2	0.052
34. Benefit	2.722	2	0.256
35. Available	7.940	4	0.094
36. Opportunity	1.548	1	0.213

Linear Programming and Other Math Programming Methods

Question	X^2	df	Probability
37. Familiar	9.107	3	0.028
38. Use	5.606	2	0.061
39. Benefit	5.020	2	0.081
40. Available	0.941	2	0.625
41. Opportunity	1.526	2	0.466

Simulation

Question	X^2	df	Probability
42. Familiar	4.961	2	0.084
43. Use	0.959	2	0.619
44. Benefit	6.268	3	0.099
45. Available	0.292	2	0.864
46. Opportunity	2.824	2	0.244

Project Selection

Question	X^2	df	Probability
47. Familiar	12.641	2	0.002
48. Use	0.403	2	0.818
49. Benefit	5.227	2	0.073
50. Available	4.593	2	0.101
51. Opportunity	1.536	2	0.464

Decision Theory

Question	X^2	df	Probability
52. Familiar	3.030	3	0.220
53. Use	2.334	2	0.311
54. Benefit	2.808	3	0.422
55. Available	3.250	3	0.355
56. Opportunity	1.535	2	0.464

Ranking

Question	X^2	df	Probability
57. Familiar	5.606	4	0.231
58. Use	2.126	3	0.547
59. Benefit	2.367	4	0.669
60. Available	4.351	3	0.226
61. Opportunity	3.825	4	0.430

Networking

Question	X^2	df	Probability
62. Familiar	1.635	2	0.442
63. Use	0.246	2	0.884
64. Benefit	3.356	3	0.187
65. Available	1.477	3	0.688
66. Opportunity	0.595	2	0.743

Financial Methods

Question	X^2	df	Probability
67. Familiar	10.444	3	0.015
68. Use	12.117	4	0.017
69. Benefit	8.567	4	0.073
70. Available	8.066	4	0.089
71. Opportunity	12.089	4	0.017

Appendix G: Wilcoxon Rank Sum Test Results of Comparison between Control and Treatment Groups' Quantitative Decision Support Technique Responses

Statistical Analysis

Question	Wilcoxon T	Probability
32. Familiar	2.544	0.0110
33. Use	1.932	0.0534
34. Benefit	1.288	0.1978
35. Available	1.378	0.1684
36. Opportunity	1.479	0.1391

Linear Programming and Other Math Programing Methods

Question	Wilcoxon T	Probability
37. Familiar	2.874	0.0041
38. Use	1.405	0.1601
39. Benefit	1.098	0.2721
40. Available	0.639	0.5227
41. Opportunity	0.826	0.4085

Simulation

Question	Wilcoxon T	Probability
42. Familiar	2.416	0.0157
43. Use	0.027	0.9788
44. Benefit	0.128	0.8984
45. Available	0.326	0.7442
46. Opportunity	0.069	0.9448

Project Selection Techniques

Question	Wilcoxon T	Probability
47. Familiar	2.430	0.0151
48. Use	0.287	0.7738
49. Benefit	0.906	0.3651
50. Available	1.623	0.1046
51. Opportunity	0.963	0.3355

Decision Theory

Question	Wilcoxon T	Probability
52. Familiar	1.043	0.2970
53. Use	0.700	0.4842
54. Benefit	0.049	0.9611
55. Available	0.229	0.8190
56. Opportunity	0.372	0.7095

Ranking

Question	Wilcoxon T	Probability
57. Familiar	1.203	0.2291
58. Use	0.937	0.3490
59. Benefit	0.843	0.3994
60. Available	0.810	0.4179
61. Opportunity	0.832	0.4055

Networking

Question	Wilcoxon T	Probability
62. Familiar	0.894	0.3713
63. Use	0.245	0.8066
64. Benefit	0.809	0.4186
65. Available	0.740	0.4595
66. Opportunity	0.479	0.6320

Financial Methods

Question	Wilcoxon T	Probability
67. Familiar	2.717	0.0066
68. Use	2.837	0.0046
69. Benefit	2.386	0.0170
70. Available	2.488	0.0128
71. Opportunity	2.899	0.0037

Appendix H: Student's t Test Results of Comparison between Control and Treatment Groups' Quantitative Decision Support Technique Responses

Statistical Analysis

Question	t	df	Probability
32. Familiar	-2.o32	62.5	0.006
33. Use	-1.999	71.8	0.049
34. Benefit	-1.432	68.1	0.157
35. Available	-1.484	68.1	0.143
36. Opportunity	-1.575	71.5	0.120

Linear Programming and Other Math Programing Methods

Question	t	df	Probability
37. Familiar	-3.084	66.6	0.003
38. Use	-1.678	63.4	0.098
39. Benefit	-1.063	71.8	0.292
40. Available	-0.558	66.1	0.579
41. Opportunity	-0.726	70.5	0.470

Simulation

Question	t	df	Probability
42. Familiar	-2.740	66.7	0.008
43. Use	-0.201	66.6	0.841
44. Benefit	0.049	72.6	0.961
45. Available	-0.422	66.7	0.675
46. Opportunity	-0.028	71.8	0.978

Project Selection Techniques

Question	t	df	Probability
47. Familiar	-1.997	71.8	0.050
48. Use	-0.504	61.5	0.616
49. Benefit	-0.664	70.8	0.509
50. Available	-1.733	59.5	0.088
51. Opportunity	-0.969	66.9	0.336

Decision Theory

Question	t	df	Probability
52. Familiar	-1.273	71.8	0.207
53. Use	-0.581	71.8	0.563
54. Benefit	0.038	71.7	0.970
55. Available	-0.077	72.4	0.939
56. Opportunity	-0.580	69.0	0.564

Ranking

Question	t	df	Probability
57. Familiar	-1.337	72.4	0.185
58. Use	-0.984	67.6	0.328
59. Benefit	-0.980	69.0	0.330
60. Available	-0.768	67.3	0.445
61. Opportunity	-0.912	69.1	0.365

Networking

Question	t	df	Probability
62. Familiar	-0.993	69.5	0.324
63. Use	0.095	72.5	0.925
64. Benefit	0.590	72.9	0.557
65. Available	0.697	71.8	0.488
66. Opportunity	0.347	71.3	0.730

Financial Methods

Question	t	df	Probability
67. Familiar	-3.164	68.8	0.002
68. Use	-3.161	69.0	0.002
69. Benefit	-2.614	70.7	0.011
70. Available	-2.632	69.9	0.011
71. Opportunity	-3.158	69.3	0.002

Appendix I: Means of Control and Treatment Groups' Quantitative Decision Support Technique Responses

Statistical Analysis

	CONTROL			TREATMENT		
	N	MEAN	STD DEV	N	MEAN	STD DEV
32. Familiar	41	2.76	0.830	34	3.38	1.045
33. Use	41	1.88	0.927	34	2.29	0.871
34. Benefit	41	2.51	0.810	34	2.79	0.880
35. Available	40	2.45	1.280	34	2.91	1.379
36. Opportunity	41	2.39	0.802	34	2.68	0.768

Linear Programming and Other Math Programing Methods

	CONTROL			TREATMENT		
	N	MEAN	STD DEV	N	MEAN	STD DEV
37. Familiar	41	2.04	1.048	34	2.85	1.184
38. Use	41	1.44	0.673	34	1.74	0.828
39. Benefit	41	1.93	0.985	33	2.15	0.834
40. Available	41	1.93	1.253	32	2.09	1.279
41. Opportunity	41	1.90	0.970	33	2.06	0.899

Simulation

	CONTROL			TREATMENT		
	N	MEAN	STD DEV	N	MEAN	STD DEV
42. Familiar	41	2.53	1.027	34	3.24	1.156
43. Use	41	1.95	0.973	34	2.00	1.101
44. Benefit	41	2.51	1.143	34	2.50	1.022
45. Available	41	2.29	1.289	33	2.42	1.370
46. Opportunity	41	2.32	1.035	34	2.32	0.976

Project Selection Techniques

	CONTROL			TREATMENT		
	N	MEAN	STD DEV	N	MEAN	STD DEV
47. Familiar	40	1.75	1.104	34	2.24	0.987
48. Use	40	1.35	0.662	34	1.44	0.860
49. Benefit	40	1.65	0.947	34	1.79	0.914
50. Available	41	1.39	0.771	34	1.76	1.046
51. Opportunity	41	1.61	0.891	34	1.82	0.999

Decision Theory

	CONTROL N	MEAN	STD DEV	TREATMENT N	MEAN	STD DEV
52. Familiar	41	2.98	0.907	34	3.24	0.855
53. Use	40	2.08	1.023	34	2.20	0.914
54. Benefit	40	2.45	1.061	34	2.44	0.960
55. Available	41	2.24	1.220	34	2.26	1.109
56. Opportunity	41	2.20	0.928	34	2.32	0.976

Ranking

	CONTROL N	MEAN	STD DEV	TREATMENT N	MEAN	STD DEV
57. Familiar	41	2.63	1.240	34	2.97	0.937
58. Use	40	2.18	1.059	33	2.42	1.091
59. Benefit	41	2.49	1.052	33	2.73	1.039
60. Available	41	2.10	1.281	33	2.33	1.339
61. Opportunity	41	2.34	1.109	33	2.58	1.091

Networking

	CONTROL N	MEAN	STD DEV	TREATMENT N	MEAN	STD DEV
62. Familiar	41	3.68	0.850	34	3.88	0.880
63. Use	41	3.17	1.138	34	3.15	1.019
64. Benefit	41	3.34	1.109	34	3.21	0.880
65. Available	41	3.32	1.274	34	3.12	1.200
66. Opportunity	41	3.15	1.108	34	3.06	1.071

Financial Methods

	CONTROL N	MEAN	STD DEV	TREATMENT N	MEAN	STD DEV
67. Familiar	40	2.88	1.017	34	3.65	1.070
68. Use	39	2.28	1.146	34	3.15	1.184
69. Benefit	40	2.63	1.213	34	3.35	1.178
70. Available	39	2.44	1.353	34	3.26	1.333
71. Opportunity	39	2.36	1.224	33	3.24	1.146

Appendix J: Demographic Influence on Decision Support Technique Responses

1.PRODUCT DIVISION Question on Familiarity	Kruskal-Wallis df = 3 X^2	Probability
32. Statistical Analysis	3.35	0.3403
37. Linear Programming	5.44	0.1421
42. Simulation	5.94	0.1144
47. Project Selection	1.71	0.6354
52. Decision Theory	3.30	0.3475
57. Ranking	3.90	0.2729
62. Networking	3.18	0.3653
67. Financial Methods	5.47	0.1402

1.PRODUCT DIVISION Question on Use	Kruskal-Wallis df = 3 X^2	Probability
33. Statistical Analysis	6.15	0.1047
38. Linear Programming	5.31	0.1507
43. Simulation	5.88	0.1177
48. Project Selection	2.81	0.4222
53. Decision Theory	8.59	0.0353
58. Ranking	6.46	0.0912
63. Networking	2.25	0.5221
68. Financial Methods	7.17	0.0666

1.PRODUCT DIVISION Question on Benefit	Kruskal-Wallis df = 3 X^2	Probability
34. Statistical Analysis	1.20	0.7521
39. Linear Programming	3.62	0.3054
44. Simulation	5.04	0.1689
49. Project Selection	5.67	0.1287
54. Decision Theory	2.60	0.4582
59. Ranking	7.17	0.0667
64. Networking	1.07	0.7846
69. Financial Methods	6.03	0.1099

1.PRODUCT DIVISION Question on Availability	Kruskal-Wallis df = 3 X^2	Probability
35. Statistical Analysis	6.85	0.0770
40. Linear Programming	6.50	0.0898
45. Simulation	6.21	0.1016
50. Project Selection	4.40	0.2213
55. Decision Theory	4.80	0.1869
60. Ranking	5.77	0.1232
65. Networking	2.32	0.5082
70. Financial Methods	4.19	0.2416

1.PRODUCT DIVISION Question on Opportunity	Kruskal-Wallis df = 3 X^2	Probability
36. Statistical Analysis	7.22	0.0651
41. Linear Programming	4.53	0.2095
46. Simulation	7.72	0.0521
51. Project Selection	4.61	0.2025
56. Decision Theory	2.68	0.4437
61. Ranking	9.14	0.0275
66. Networking	2.18	0.5351
71. Financial Methods	4.05	0.2558

2.RANK Question on Familiarity	Kruskal-Wallis df = 4 X^2	Probability
32. Statistical Analysis	3.49	0.4795
37. Linear Programming	8.67	0.0700
42. Simulation	3.75	0.4409
47. Project Selection	6.35	0.1744
52. Decision Theory	6.83	0.1450
57. Ranking	4.07	0.3962
62. Networking	7.80	0.0993
67. Financial Methods	7.73	0.1018

2.RANK Question on Use	Kruskal-Wallis df = 4 X^2	Probability
33. Statistical Analysis	4.06	0.3977
38. Linear Programming	3.56	0.4681
43. Simulation	2.35	0.6718
48. Project Selection	2.73	0.6040
53. Decision Theory	2.68	0.6124
58. Ranking	1.25	0.8700
63. Networking	2.37	0.6689
68. Financial Methods	7.57	0.1086

2. RANK Question on Benefit	Kruskal-Wallis df = 4 X^2	Probability
34. Statistical Analysis	7.96	0.0931
39. Linear Programming	5.61	0.2306
44. Simulation	1.02	0.9074
49. Project Selection	2.47	0.6495
54. Decision Theory	0.85	0.9317
59. Ranking	4.55	0.3366
64. Networking	1.49	0.8283
69. Financial Methods	5.60	0.2314

2. RANK Question on Availability	Kruskal-Wallis df = 4 X^2	Probability
35. Statistical Analysis	5.41	0.2482
40. Linear Programming	7.84	0.0975
45. Simulation	2.82	0.5887
50. Project Selection	2.61	0.6251
55. Decision Theory	1.46	0.8331
60. Ranking	2.76	0.5988
65. Networking	2.18	0.7025
70. Financial Methods	8.38	0.0787

2. RANK Question on Opportunity	Kruskal-Wallis df = 4 X^2	Probability
36. Statistical Analysis	4.75	0.3140
41. Linear Programming	6.19	0.1857
46. Simulation	3.28	0.5116
51. Project Selection	2.13	0.7118
56. Decision Theory	1.01	0.9080
61. Ranking	2.21	0.6966
66. Networking	1.74	0.7832
71. Financial Methods	5.89	0.2075

3. HIGHEST DEGREE Question on Familiarity	Kruskal-Wallis df = 3 X^2	Probability
32. Statistical Analysis	1.15	0.7640
37. Linear Programming	2.31	0.5102
42. Simulation	1.03	0.7949
47. Project Selection	2.14	0.5434
52. Decision Theory	6.42	0.0928
57. Ranking	1.39	0.7079
62. Networking	2.41	0.4915
67. Financial Methods	2.76	0.4296

3.HIGHEST DEGREE Question on Use	Kruskal-Wallis df = 3 X^2	Probability
33. Statistical Analysis	5.11	0.1641
38. Linear Programming	0.78	0.8535
43. Simulation	0.45	0.9301
48. Project Selection	3.65	0.3024
53. Decision Theory	1.55	0.6698
58. Ranking	2.64	0.2666
63. Networking	7.15	0.0671
68. Financial Methods	2.50	0.4755

3.HIGHEST DEGREE Question on Benefit	Kruskal-Wallis df = 3 X^2	Probability
34. Statistical Analysis	10.54	0.0145
39. Linear Programming	0.56	0.9048
44. Simulation	0.97	0.8082
49. Project Selection	3.22	0.3592
54. Decision Theory	1.02	0.7959
59. Ranking	2.49	0.4771
64. Networking	3.31	0.3456
69. Financial Methods	2.75	0.4325

3.HIGHEST DEGREE Question on Availability	Kruskal-Wallis df = 3 X^2	Probability
35. Statistical Analysis	2.64	0.4504
40. Linear Programming	0.91	0.8235
45. Simulation	2.25	0.5218
50. Project Selection	2.07	0.5585
55. Decision Theory	0.33	0.9540
60. Ranking	0.83	0.8428
65. Networking	1.51	0.6789
70. Financial Methods	1.25	0.7399

3.HIGHEST DEGREE Question on Opportunity	Kruskal-Wallis df = 3 X^2	Probability
36. Statistical Analysis	4.06	0.2556
41. Linear Programming	0.59	0.8993
46. Simulation	0.30	0.9601
51. Project Selection	2.43	0.4889
56. Decision Theory	1.38	0.7101
61. Ranking	2.99	0.3935
66. Networking	6.66	0.0835
71. Financial Methods	1.28	0.7345

4. FIELD OF STUDY Question on Familiarity	Kruskal-Wallis df = 3 X^2	Probability
32. Statistical Analysis	3.15	0.3697
37. Linear Programming	5.76	0.1239
42. Simulation	2.77	0.4289
47. Project Selection	4.93	0.1766
52. Decision Theory	5.44	0.1424
57. Ranking	1.18	0.7574
62. Networking	5.10	0.1643
67. Financial Methods	3.28	0.3501

4. FIELD OF STUDY Question on Use	Kruskal-Wallis df = 3 X^2	Probability
33. Statistical Analysis	2.45	0.4837
38. Linear Programming	3.44	0.3292
43. Simulation	2.23	0.5271
48. Project Selection	2.50	0.4760
53. Decision Theory	0.85	0.8364
58. Ranking	1.20	0.7528
63. Networking	0.88	0.8304
68. Financial Methods	3.97	0.2649

4. FIELD OF STUDY Question on Benefit	Kruskal-Wallis df = 3 X^2	Probability
34. Statistical Analysis	0.61	0.8942
39. Linear Programming	6.29	0.0984
44. Simulation	1.42	0.6997
49. Project Selection	6.50	0.0896
54. Decision Theory	0.23	0.9725
59. Ranking	0.96	0.8106
64. Networking	0.58	0.9017
69. Financial Methods	3.51	0.3189

4. FIELD OF STUDY Question on Availability	Kruskal-Wallis df = 3 X^2	Probability
35. Statistical Analysis	1.53	0.6761
40. Linear Programming	2.30	0.5119
45. Simulation	0.85	0.8377
50. Project Selection	1.90	0.5941
55. Decision Theory	0.07	0.9948
60. Ranking	0.63	0.8887
65. Networking	2.35	0.5027
70. Financial Methods	1.27	0.7361

4.FIELD OF STUDY Question on Opportunity	Kruskal-Wallis df = 3 X^2	Probability
36. Statistical Analysis	2.00	0.5718
41. Linear Programming	6.31	0.0976
46. Simulation	1.12	0.7719
51. Project Selection	2.58	0.4605
56. Decision Theory	0.50	0 9200
61. Ranking	1.11	0.7750
66. Networking	0.97	0.8081
71. Financial Methods	1.89	0.5965

5.SPO TYPE Question on Familiarity	Kruskal-Wallis df = 2 X^2	Probability
32. Statistical Analysis	3.53	0.1715
37. Linear Programming	4.83	0.0893
42. Simulation	1.45	0.4836
47. Project Selection	1.00	0.6054
52. Decision Theory	2.25	0.3241
57. Ranking	4.05	0.1321
62. Networking	0.96	0.6180
67. Financial Methods	1.11	0.5739

5.SPO TYPE Question on Use	Kruskal-Wallis df = 2 X^2	Probability
33. Statistical Analysis	6.25	0.0439
38. Linear Programming	2.90	0.2347
43. Simulation	4.81	0.0901
48. Project Selection	2.60	0.2728
53. Decision Theory	3.05	0.2172
58. Ranking	2.51	0.2852
63. Networking	0.37	0.8303
68. Financial Methods	0.15	0.9287

5.SPO TYPE Question on Benefit	Kruskal-Wallis df = 2 X^2	Probability
34. Statistical Analysis	0.77	0.6798
39. Linear Programming	3.13	0.2089
44. Simulation	4.59	0.1007
49. Project Selection	1.86	0.3942
54. Decision Theory	2.42	0.2980
59. Ranking	2.97	0.2265
64. Networking	0.43	0.8053
69. Financial Methods	0.17	0.9192

5.SPO TYPE Question on Availability	Kruskal-Wallis df = 2 X^2	Probability
35. Statistical Analysis	1.10	0.5779
40. Linear Programming	2.03	0.3628
45. Simulation	3.68	0.1588
50. Project Selection	7.98	0.0185
55. Decision Theory	0.58	0.7478
60. Ranking	3.74	0.1542
65. Networking	0.43	0.8066
70. Financial Methods	0.62	0.7325

5.SPO TYPE Question on Opportunity	Kruskal-Wallis df = 2 X^2	Probability
36. Statistical Analysis	6.55	0.0378
41. Linear Programming	5.40	0.0674
46. Simulation	1.85	0.3961
51. Project Selection	3.62	0.1637
56. Decision Theory	1.03	0.5978
61. Ranking	2.51	0.2857
66. Networking	0.19	0.9094
71. Financial Methods	2.72	0.2571

6.JOB POSITION Question on Familiarity	Kruskal-Wallis df = 3 X^2	Probability
32. Statistical Analysis	2.09	0.3519
37. Linear Programming	7.20	0.0273
42. Simulation	3.58	0.1668
47. Project Selection	1.82	0.4033
52. Decision Theory	1.14	0.5660
57. Ranking	1.38	0.5026
62. Networking	1.66	0.4360
67. Financial Methods	3.62	0.1638

6.JOB POSITION Question on Use	Kruskal-Wallis df = 3 X^2	Probability
33. Statistical Analysis	6.08	0.0479
38. Linear Programming	6.09	0.0477
43. Simulation	4.75	0.0930
48. Project Selection	1.78	0.4114
53. Decision Theory	4.26	0.1190
58. Ranking	0.04	0.9815
63. Networking	1.05	0.5920
68. Financial Methods	3.89	0.1433

6.JOB POSITION Question on Benefit	Kruskal-Wallis df = 3 X^2	Probability
34. Statistical Analysis =	3.43	0.1802
39. Linear Programming	0.81	0.6673
44. Simulation	1.91	0.3847
49. Project Selection	0.19	0.9077
54. Decision Theory	5.44	0.0660
59. Ranking	0.04	0.9815
64. Networking	2.40	0.3009
69. Financial Methods	3.42	0.1810

6.JOB POSITION Question on Availability	Kruskal-Wallis df = 3 X^2	Probability
35. Statistical Analysis	12.35	0.0021
40. Linear Programming	5.24	0.0727
45. Simulation	5.56	0.0622
50. Project Selection	0.05	0.9770
55. Decision Theory	0.11	0.9482
60. Ranking	4.84	0.0888
65. Networking	1.95	0.3777
70. Financial Methods	1.89	0.3891

6.JOB POSITION Question on Opportunity	Kruskal-Wallis df = 3 X^2	Probability
36. Statistical Analysis	6.70	0.0350
41. Linear Programming	0.16	0.9234
46. Simulation	1.06	0.5875
51. Project Selection	0.35	0.8406
56. Decision Theory	2.70	0.2596
61. Ranking	1.41	0.4953
66. Networking	4.46	0.1076
71. Financial Methods	2.38	0.3049

7.CUM. EXPERIENCE Question on Familiarity	Kruskal-Wallis df = 4 X^2	Probability
32. Statistical Analysis	3.53	0.4728
37. Linear Programming	6.25	0.1809
42. Simulation	5.84	0.2118
47. Project Selection	5.30	0.2577
52. Decision Theory	5.09	0.2780
57. Ranking	4.88	0.2998
62. Networking	6.16	0.1874
67. Financial Methods	8.73	0.0683

7.CUM. EXPERIENCE Question on Use	Kruskal-Wallis df = 4 X^2	Probability
33. Statistical Analysis	1.92	0.7506
38. Linear Programming	4.99	0.2880
43. Simulation	2.17	0.7041
48. Project Selection	4.99	0.2886
53. Decision Theory	8.52	0.0744
58. Ranking	8.89	0.0640
63. Networking	4.74	0.3148
68. Financial Methods	12.11	0.0166

7.CUM. EXPERIENCE Question on Benefit	Kruskal-Wallis df = 4 X^2	Probability
34. Statistical Analysis	7.70	0.1033
39. Linear Programming	6.82	0.1458
44. Simulation	1.58	0.8120
49. Project Selection	3.11	0.5404
54. Decision Theory	4.23	0.3752
59. Ranking	6.81	0.1462
64. Networking	4.97	0.2900
69. Financial Methods	12.39	0.0147

7.CUM. EXPERIENCE Question on Availability	Kruskal-Wallis df = 4 X^2	Probability
35. Statistical Analysis	6.11	0.1909
40. Linear Programming	5.70	0.2224
45. Simulation	5.61	0.2300
50. Project Selection	2.08	0.7210
55. Decision Theory	10.79	0.0290
60. Ranking	6.46	0.1674
65. Networking	10.77	0.0293
70. Financial Methods	11.69	0.0198

7.CUM. EXPERIENCE Question on Opportunity	Kruskal-Wallis df = 4 X^2	Probability
36. Statistical Analysis	3.53	0.4738
41. Linear Programming	2.55	0.6355
46. Simulation	3.00	0.5586
51. Project Selection	3.78	0.4370
56. Decision Theory	4.80	0.3087
61. Ranking	6.57	0.1602
66. Networking	9.79	0.0440
71. Financial Methods	12.16	0.0162

8. AGE GROUP Question on Familiarity	Kruskal-Wallis df = 4 X^2	Probability
32. Statistical Analysis	1.27	0.8660
37. Linear Programming	2.35	0.6726
42. Simulation	2.74	0.6023
47. Project Selection	3.03	0.5533
52. Decision Theory	4.45	0.3488
57. Ranking	2.14	0.7098
62. Networking	2.86	0.5823
67. Financial Methods	3.54	0.4712

8. AGE GROUP Question on Use	Kruskal-Wallis df = 4 X^2	Probability
33. Statistical Analysis	7.55	0.1096
38. Linear Programming	2.83	0.5866
43. Simulation	1.18	0.8812
48. Project Selection	2.51	0.6437
53. Decision Theory	4.71	0.3181
58. Ranking	2.15	0.7082
63. Networking	1.62	0.8049
68. Financial Methods	5.00	0.2877

8. AGE GROUP Question on Benefit	Kruskal-Wallis df = 4 X^2	Probability
34. Statistical Analysis	4.91	0.2968
39. Linear Programming	4.35	0.3608
44. Simulation	2.14	0.7100
49. Project Selection	8.02	0.0908
54. Decision Theory	4.61	0.3301
59. Ranking	2.08	0.7218
64. Networking	6.44	0.1684
69. Financial Methods	2.25	0.6890

8. AGE GROUP Question on Availability	Kruskal-Wallis df = 4 X^2	Probability
35. Statistical Analysis	0.09	0.9990
40. Linear Programming	0.33	0.9877
45. Simulation	1.74	0.7840
50. Project Selection	2.00	0.7365
55. Decision Theory	0.55	0.9682
60. Ranking	0.48	0.9758
65. Networking	1.00	0.9095
70. Financial Methods	3.60	0.4627

8. AGE GROUP Question on Opportunity	Kruskal-Wallis df = 4 X^2	Probability
36. Statistical Analysis	6.11	0.1912
41. Linear Programming	5.29	0.2584
46. Simulation	0.67	0.9548
51. Project Selection	5.62	0.2295
56. Decision Theory	1.87	0.7595
61. Ranking	1.17	0.8831
66. Networking	4.69	0.3210
71. Financial Methods	5.75	0.2182

9. ACQUISITION PHASE Question on Familiarity	Kruskal-Wallis df = 3 X^2	Probability
32. Statistical Analysis	3.50	0.3216
37. Linear Programming	7.86	0.0489
42. Simulation	8.87	0.0311
47. Project Selection	1.53	0.6754
52. Decision Theory	4.15	0.2454
57. Ranking	6.58	0.0867
62. Networking	0.97	0.8092
67. Financial Methods	3.43	0.3303

9. ACQUISITION PHASE Question on Use	Kruskal-Wallis df = 3 X^2	Probability
33. Statistical Analysis	5.34	0.1485
38. Linear Programming	5.95	0.1139
43. Simulation	6.11	0.1063
48. Project Selection	2.00	0.5723
53. Decision Theory	2.97	0.3962
58. Ranking	7.12	0.0681
63. Networking	1.83	0.6079
68. Financial Methods	6.56	0.0874

9. ACQUISITION PHASE Question on Benefit	Kruskal-Wallis df = 3 X^2	Probability
34. Statistical Analysis	2.51	0.4736
39. Linear Programming	2.42	0.4901
44. Simulation	0.89	0.8282
49. Project Selection	0.91	0.8227
54. Decision Theory	5.93	0.1149
59. Ranking	8.62	0.0348
64. Networking	1.30	0.7289
69. Financial Methods	1.30	0.7298

9.ACQUISITION PHASE Question on Availability	Kruskal-Wallis df = 3 X^2	Probability
35. Statistical Analysis	10.57	0.0143
40. Linear Programming	12.35	0.0063
45. Simulation	17.64	0.0005
50. Project Selection	4.23	0.2372
55. Decision Theory	6.70	0.0821
60. Ranking	14.30	0.0025
65. Networking	3.15	0.3690
70. Financial Methods	6.03	0.1102

9.ACQUISITION PHASE Question on Opportunity	Kruskal-Wallis df = 3 X^2	Probability
36. Statistical Analysis	3.23	0.3574
41. Linear Programming	2.06	0.5602
46. Simulation	1.55	0.6699
51. Project Selection	2.00	0.5727
55. Decision Theory	5.50	0.1387
61. Ranking	3.60	0.3082
66. Networking	1.20	0.7540
71. Financial Methods	2.94	0.4016

10.COMPUTER FAM Question on Familiarity	Kruskal-Wallis df = 4 X^2	Probability
32. Statistical Analysis	9.91	0.0419
37. Linear Programming	10.05	0.0396
42. Simulation	11.00	0.0265
47. Project Selection	4.58	0.3330
52. Decision Theory	11.57	0.0209
57. Ranking	6.49	0.1655
62. Networking	10.15	0.0380
67. Financial Methods	7.08	0.1315

10.COMPUTER FAM Question on Use	Kruskal-Wallis df = 4 X^2	Probability
33. Statistical Analysis	5.61	0.2305
38. Linear Programming	10.60	0.0315
43. Simulation	1.56	0.8161
48. Project Selection	3.45	0.4849
53. Decision Theory	4.06	0.3976
58. Ranking	3.65	0.4557
63. Networking	5.25	0.2622
68. Financial Methods	5.98	0.2009

10. COMPUTER FAM Question on Benefit	Kruskal-Wallis df = 4 X^2	Probability
34. Statistical Analysis	7.46	0.1133
39. Linear Programming	6.23	0.1825
44. Simulation	2.44	0.6546
49. Project Selection	4.01	0.4046
54. Decision Theory	4.19	0.3809
59. Ranking	1.21	0.8772
64. Networking	2.55	0.6353
69. Financial Methods	3.89	0.4210

10. COMPUTER FAM Question on Availability	Kruskal-Wallis df = 4 X^2	Probability
35. Statistical Analysis	3.19	0.5260
40. Linear Programming	1.89	0.7554
45. Simulation	3.54	0.4715
50. Project Selection	0.53	0.9704
55. Decision Theory	1.02	0.9065
60. Ranking	3.46	0.4847
65. Networking	4.96	0.2910
70. Financial Methods	3.36	0.4989

10. COMPUTER FAM Question on Opportunity	Kruskal-Wallis df = 4 X^2	Probability
36. Statistical Analysis	6.97	0.1372
41. Linear Programming	2.34	0.6743
46. Simulation	1.86	0.7619
51. Project Selection	3.17	0.5294
56. Decision Theory	1.39	0.8451
61. Ranking	1.07	0.8991
66. Networking	5.21	0.2661
71. Financial Methods	4.25	0.3736

11. COMPUTER USE Question on Familiarity	Kruskal-Wallis df = 4 X^2	Probability
32. Statistical Analysis	6.62	0.1574
37. Linear Programming	8.13	0.0869
42. Simulation	5.53	0.2375
47. Project Selection	1.49	0.8289
52. Decision Theory	6.51	0.1640
57. Ranking	2.70	0.6101
62. Networking	7.07	0.1323
67. Financial Methods	7.46	0.1135

11. COMPUTER USE Question on Use	Kruskal-Wallis df = 4 X^2	Probability
33. Statistical Analysis	5.43	0.2457
38. Linear Programming	9.80	0.0440
43. Simulation	0.76	0.9441
48. Project Selection	2.01	0.7330
53. Decision Theory	0.93	0.9197
58. Ranking	1.36	0.8511
63. Networking	3.72	0.4459
68. Financial Methods	12.93	0.0116

11. COMPUTER USE Question on Benefit	Kruskal-Wallis df = 4 X^2	Probability
34. Statistical Analysis	5.40	0.2486
39. Linear Programming	10.13	0.0382
44. Simulation	3.21	0.5230
49. Project Selection	6.09	0.1923
54. Decision Theory	4.50	0.3430
59. Ranking	6.21	0.1841
64. Networking	5.80	0.2143
69. Financial Methods	12.43	0.0144

11. COMPUTER USE Question on Availability	Kruskal-Wallis df = 4 X^2	Probability
35. Statistical Analysis	2.91	0.5726
40. Linear Programming	3.48	0.4804
45. Simulation	6.75	0.1495
50. Project Selection	0.41	0.9812
55. Decision Theory	1.85	0.7638
60. Ranking	3.10	0.5413
65. Networking	5.59	0.2323
70. Financial Methods	9.91	0.0420

11. COMPUTER USE Question on Opportunity	Kruskal-Wallis df = 4 X^2	Probability
36. Statistical Analysis	13.23	0.0102
41. Linear Programming	12.02	0.0172
46. Simulation	3.88	0.4222
51. Project Selection	8.21	0.0843
56. Decision Theory	3.29	0.5110
61. Ranking	3.37	0.4977
66. Networking	6.67	0.1544
71. Financial Methods	17.43	0.0016

Appendix K: Logistics Influence on Decision Support Technique Responses

15. LOGISTICS Question on Familiarity	Kruskal-Wallis df = 4 X^2	Probability
32. Statistical Analysis	5.58	0.2326
37. Linear Programming	6.12	0.1906
42. Simulation	6.31	0.1774
47. Project Selection	9.25	0.0551
52. Decision Theory	8.56	0.0732
57. Ranking	10.72	0.0299
62. Networking	6.85	0.1439
67. Financial Methods	10.58	0.0317

15. LOGISTICS Question on Use	Kruskal-Wallis df = 4 X^2	Probability
33. Statistical Analysis	2.53	0.6396
38. Linear Programming	3.71	0.4470
43. Simulation	4.14	0.3874
48. Project Selection	5.47	0.2424
53. Decision Theory	7.84	0.0975
58. Ranking	10.69	0.0303
63. Networking	4.74	0.3145
68. Financial Methods	2.74	0.6027

15. LOGISTICS Question on Benefit	Kruskal-Wallis df = 4 X^2	Probability
34. Statistical Analysis	1.02	0.9065
39. Linear Programming	10.84	0.0284
44. Simulation	2.42	0.6599
49. Project Selection	10.31	0.0355
54. Decision Theory	5.79	0.2156
59. Ranking	13.23	0.0102
64. Networking	3.57	0.4676
69. Financial Methods	5.48	0.2412

15. LOGISTICS Question on Availability	Kruskal-Wallis df = 4 X^2	Probability
35. Statistical Analysis	2.62	0.6232
40. Linear Programming	8.36	0.0793
45. Simulation	0.63	0.9593
50. Project Selection	5.33	0.2555
55. Decision Theory	10.20	0.0372
60. Ranking	9.21	0.0562
65. Networking	1.38	0.8476
70. Financial Methods	4.02	0.4034

15. LOGISTICS Question on Opportunity	Kruskal-Wallis df = 4 X^2	Probability
36. Statistical Analysis	3.20	0.5245
41. Linear Programming	7.02	0.1350
46. Simulation	5.74	0.2191
51. Project Selection	8.44	0.0768
56. Decision Theory	4.99	0.2880
61. Ranking	11.35	0.0229
66. Networking	6.58	0.1599
71. Financial Methods	3.76	0.4388

Appendix L: Frequency of Responses

Statistical Analysis

QUESTION	RESPONSE	CONTROL FREQUENCY	CONTROL %	TREATMENT FREQUENCY	TREATMENT %
32.	NONE	2	4.9	1	2.9
FAMILIAR	SLIGHTLY	13	31.7	5	14.7
	MODERATELY	20	48.8	14	41.2
	VERY	5	12.2	8	23.5
	COMPLETELY	1	2.4	6	17.6
33.	NEVER	18	43.9	6	17.6
USE	SELDOM	12	29.3	15	44.1
	OCCASIONALLY	9	22.0	10	29.4
	OFTEN	2	4.9	3	8.8
	ALWAYS	0	0.0	0	0.0
34.	NEVER	4	9.8	2	5.9
BENEFIT	SELDOM	16	39.0	11	32.4
	OCCASIONALLY	17	41.5	13	38.2
	OFTEN	4	9.8	8	23.5
	ALWAYS	0	0.0	0	0.0
35.	NO ANSWER	1	N/A	0	N/A
AVAILABLE	NONE	10	25.0	3	8.8
	SLIGHTLY	15	37.5	17	50.0
	MODERATELY	6	15.0	1	2.9
	VERY	5	12.5	6	17.6
	COMPLETELY	4	10.0	7	20.6
36.	NEVER	4	9.8	1	2.9
OPPORTUNITY	SELDOM	20	48.8	14	41.2
	OCCASIONALLY	15	36.6	14	41.2
	OFTEN	1	2.4	5	14.7
	ALWAYS	1	2.4	0	0.0

Linear Programming and Other Math Programing Methods

QUESTION	RESPONSE	CONTROL FREQUENCY	CONTROL %	TREATMENT FREQUENCY	TREATMENT %
37. FAMILIAR	NONE	15	36.6	5	14.7
	SLIGHTLY	14	34.1	8	23.5
	MODERATELY	8	19.5	11	32.4
	VERY	3	7.3	7	20.6
	COMPLETELY	1	2.4	3	8.8
38. USE	NEVER	26	63.4	17	50.0
	SELDOM	13	31.7	9	26.5
	OCCASIONALLY	1	2.4	8	23.5
	OFTEN	1	2.4	0	0.0
	ALWAYS	0	0.0	0	0.0
39. BENEFIT	NO ANSWER	0	N/A	1	N/A
	NEVER	19	46.3	8	24.2
	SELDOM	8	19.5	13	39.4
	OCCASIONALLY	12	29.3	11	33.3
	OFTEN	2	4.9	1	3.0
	ALWAYS	0	0.0	0	0.0
40. AVAILABLE	NO ANSWER	0	N/A	2	N/A
	NONE	22	53.7	14	43.8
	SLIGHTLY	8	19.5	9	28.1
	MODERATELY	6	14.6	3	9.4
	VERY	2	4.9	4	12.5
	COMPLETELY	3	7.3	2	6.3
41. OPPORTUNITY	NO ANSWER	0	N/A	1	N/A
	NEVER	18	43.9	10	30.3
	SELDOM	12	29.3	13	39.4
	OCCASIONALLY	8	19.5	8	24.2
	OFTEN	3	7.3	2	6.1
	ALWAYS	0	0.0	0	0.0

Simulation

QUESTION	RESPONSE	CONTROL FREQUENCY	CONTROL %	TREATMENT FREQUENCY	TREATMENT %
42. FAMILIAR	NONE	7	17.1	12	35.3
	SLIGHTLY	14	34 1	16	47.1
	MODERATELY	11	26.8	2	5.9
	VERY	9	22.0	2	5.9
	COMPLETELY	0	0.0	2	5.9
43. USE	NEVER	16	39.0	3	8.8
	SELDOM	15	36.6	19	55.9
	OCCASIONALLY	6	14.6	6	17.6
	OFTEN	4	9.8	4	11.8
	ALWAYS	0	0.0	2	5.9
44. BENEFIT	NO ANSWER	0	N/A	1	N/A
	NEVER	9	22.0	9	27.3
	SELDOM	12	29.3	14	42.4
	OCCASIONALLY	12	29.3	1	3.0
	OFTEN	6	14.6	5	15.2
	ALWAYS	2	4.9	4	12.1
45. AVAILABLE	NONE	13	31.7	5	14.7
	SLIGHTLY	15	36.6	18	52.9
	MODERATELY	5	12.2	8	23.5
	VERY	4	9.8	1	2.9
	COMPLETELY	4	9.8	2	5.9
46. OPPORTUNITY	NEVER	10	24.4	7	20.6
	SELDOM	14	34.1	16	47.1
	OCCASIONALLY	12	29.3	9	26.5
	OFTEN	4	9.8	0	0.0
	ALWAYS	1	2.4	2	5.9

Project Selection

QUESTION	RESPONSE	CONTROL FREQUENCY	CONTROL %	TREATMENT FREQUENCY	TREATMENT %
47. FAMILIAR	NO ANSWER	1	N/A	0	N/A
	NONE	24	60.0	24	70.6
	SLIGHTLY	7	17.5	7	20.6
	MODERATELY	5	12.5	2	5.9
	VERY	3	7.5	0	0.0
	COMPLETELY	1	2.5	1	2.9
48. USE	NO ANSWER	1	N/A	0	N/A
	NEVER	30	75.0	24	70.6
	SELDOM	6	15.0	7	20.6
	OCCASIONALLY	4	10.0	2	5.9
	OFTEN	0	0.0	0	0.0
	ALWAYS	0	0.0	1	2.9
49. BENEFIT	NO ANSWER	1	N/A	0	N/A
	NEVER	25	62.5	15	44.1
	SELDOM	6	15.0	13	38.2
	OCCASIONALLY	7	17.5	5	14.7
	OFTEN	2	5.0	0	0.0
	ALWAYS	0	0.0	1	2.9
50. AVAILABLE	NONE	31	75.6	18	52.9
	SLIGHTLY	5	12.2	10	29.4
	MODERATELY	4	9.8	3	8.8
	VERY	1	2.4	2	5.9
	COMPLETELY	0	0.0	1	2.9
51. OPPORTUNITY	NEVER	25	61.0	16	47.1
	SELDOM	9	22.0	11	32.4
	OCCASIONALLY	5	12.2	5	14.7
	OFTEN	2	4.9	1	2.9
	ALWAYS	0	0.0	1	2.9

Frequency of Responses

Decision Theory

QUESTION	RESPONSE	CONTROL FREQUENCY	CONTROL %	TREATMENT FREQUENCY	TREATMENT %
52. FAMILIAR	NONE	1	2.4	0	0.0
	SLIGHTLY	13	31.7	6	17.6
	MODERATELY	14	34.1	17	50.0
	VERY	12	29.3	8	23.5
	COMPLETELY	1	2.4	3	8.8
53. USE	NO ANSWER	1	N/A	0	N/A
	NEVER	14	35.0	7	20.6
	SELDOM	14	35.0	17	50.0
	OCCASIONALLY	7	17.5	6	17.6
	OFTEN	5	12.5	4	11.8
	ALWAYS	0	0.0	0	0.0
54. BENEFIT	NO ANSWER	1	N/A	0	N/A
	NEVER	9	22.5	6	17.6
	SELDOM	12	30.0	11	32.4
	OCCASIONALLY	11	27.5	14	41.2
	OFTEN	8	20.0	2	5.9
	ALWAYS	0	0.0	1	2.9
55. AVAILABLE	NONE	15	36.6	9	26.5
	SLIGHTLY	11	26.8	13	38.2
	MODERATELY	6	14.6	8	23.5
	VERY	8	19.5	2	5.9
	COMPLETELY	1	2.4	2	5.9
56. OPPORTUNITY	NEVER	11	26.8	6	17.6
	SELDOM	14	34.1	16	47.1
	OCCASIONALLY	13	31.7	8	23.5
	OFTEN	3	7.3	3	8.8
	ALWAYS	0	0.0	1	2.9

Ranking

QUESTION	RESPONSE	CONTROL FREQUENCY	CONTROL %	TREATMENT FREQUENCY	TREATMENT %
57.	NONE	10	24.4	2	5.9
FAMILIAR	SLIGHTLY	8	19.5	7	20.6
	MODERATELY	13	31.7	17	50.0
	VERY	7	17.1	6	17.6
	COMPLETELY	3	7.3	2	5.9
58.	NO ANSWER	1	N/A	1	N/A
USE	NEVER	13	32.5	7	21.2
	SELDOM	13	32.5	13	39.4
	OCCASIONALLY	8	20.0	5	15.2
	OFTEN	6	15.0	8	24.2
	ALWAYS	0	0.0	0	0.0
59.	NO ANSWER	0	N/A	1	N/A
BENEFIT	NEVER	9	22.0	4	12.1
	SELDOM	11	26.8	10	30.3
	OCCASIONALLY	13	31.7	11	33.3
	OFTEN	8	19.5	7	21.2
	ALWAYS	0	0.0	1	3.0
60.	NO ANSWER	0	N/A	1	N/A
AVAILABLE	NONE	19	46.3	11	33.3
	SLIGHTLY	8	19.5	11	33.3
	MODERATELY	8	19.5	3	9.1
	VERY	3	7.3	5	15.2
	COMPLETELY	3	7.3	3	9.1
61.	NO ANSWER	0	0.0	1	N/A
OPPORTUNITY	NEVER	12	29.3	5	15.2
	SELDOM	11	26.8	13	39.4
	OCCASIONALLY	10	24.4	7	21.2
	OFTEN	8	19.5	7	21.2
	ALWAYS	0	0.0	1	3.0

Networking

QUESTION	RESPONSE	CONTROL FREQUENCY	CONTROL %	TREATMENT FREQUENCY	TREATMENT %
62.	NONE	0	0.0	0	0.0
FAMILIAR	SLIGHTLY	4	9.8	2	5.9
	MODERATELY	11	26.8	9	26.5
	VERY	20	48.8	14	41.2
	COMPLETELY	6	14.6	9	26 5
63.	NEVER	4	9.8	1	2.9
USE	SELDOM	7	17.1	9	26.5
	OCCASIONALLY	12	29.3	11	32.4
	OFTEN	14	34.1	10	29.4
	ALWAYS	4	9.8	3	8.8
64.	NEVER	3	7.3	1	2.9
BENEFIT	SELDOM	6	14.6	5	14.7
	OCCASIONALLY	11	26.8	16	47.1
	OFTEN	16	39.0	10	29.4
	ALWAYS	5	12.2	2	5.9
65.	NONE	4	9.8	3	8.8
AVAILABLE	SLIGHTLY	9	22.0	9	26.5
	MODERATELY	5	12.2	7	20.6
	VERY	16	39.0	11	32.4
	COMPLETELY	7	17.1	4	11.8
66.	NEVER	4	9.8	2	5.9
OPPORTUNITY	SELDOM	7	17.1	9	26.5
	OCCASIONALLY	12	29.3	11	32.4
	OFTEN	15	36.6	9	26.5
	ALWAYS	3	7.3	3	8.8

Financial Methods

QUESTION	RESPONSE	CONTROL FREQUENCY	CONTROL %	TREATMENT FREQUENCY	TREATMENT %
67.	NO ANSWER	1	N/A	0	N/A
FAMILIAR	NONE	5	12.5	0	0.0
	SLIGHTLY	7	17.5	6	17.6
	MODERATELY	17	42.5	9	26.5
	VERY	10	25.0	10	29.4
	COMPLETELY	1	2.5	9	26.5
68.	NO ANSWER	2	N/A	0	N/A
USE	NEVER	13	33.3	2	5.9
	SELDOM	9	23.1	10	29.4
	OCCASIONALLY	11	28.2	8	23.5
	OFTEN	5	12.8	9	26.5
	ALWAYS	1	2.6	5	14.7
69.	NO ANSWER	1	N/A	0	N/A
BENEFIT	NEVER	10	25.0	2	5.9
	SELDOM	7	17.5	7	20.6
	OCCASIONALLY	13	32.5	8	23.5
	OFTEN	8	20.0	11	32.4
	ALWAYS	2	5.0	6	17.6
70.	NO ANSWER	2	N/A	0	N/A
AVAILABLE	NONE	12	30.8	3	8.8
	SLIGHTLY	12	30.8	10	29.4
	MODERATELY	5	12.8	3	8.8
	VERY	6	15.4	11	32.4
	COMPLETELY	4	10.3	7	20.6
71.	NO ANSWER	2	N/A	1	N/A
OPPORTUNITY	NEVER	13	33.3	2	6.1
	SELDOM	8	20.5	8	24.2
	OCCASIONALLY	11	28.2	7	21.2
	OFTEN	5	12.8	12	36.4
	ALWAYS	2	5.1	4	12.1

Appendix M: Data from SYS-400 Survey

Raw survey data from the test conducted in the Intermediate Program Management (SYS-400) Professional Continuing Education (PCE) course at Wright-Patterson AFB, OH.

Raw Survey Data - SYS-400 89A - Control Group
M is the symbol for Missing data - No Answer
Q4II to Q4IV are the multiple answers, if any, to Q4
Q9II to Q9IV are the multiple answers, if any, to Q9

OBS	ID	Q1	Q2	Q3	Q4	Q4II	Q4III	Q4IV	Q5	Q6	Q7	Q8	Q9	Q9II	Q9III	Q9IV	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
1	1	2	2	2	1	3	M	M	3	4	3	3	1	M	M	M	3	2	4	4	3	4	5	1	1	3	2	1	1	3	5
2	2	2	5	2	1	M	M	M	1	2	5	3	3	4	M	M	1	1	4	5	5	4	5	2	5	3	3	2	5	3	4
3	3	2	3	2	1	M	M	M	3	4	1	3	M	M	M	M	3	3	1	1	1	1	1	1	1	1	1	1	1	1	1
4	4	2	5	1	3	M	M	M	1	4	5	4	2	3	4	M	3	3	3	4	3	3	4	1	3	5	3	2	5	2	5
5	5	2	5	2	1	M	M	M	1	2	5	5	4	M	M	M	3	2	4	5	4	2	3	1	5	1	5	1	5	3	5
6	6	2	4	2	3	M	M	M	1	2	4	5	4	M	M	M	2	3	3	5	3	3	4	3	3	3	4	1	4	3	1
7	7	1	3	2	2	M	M	M	2	2	3	3	4	M	M	M	3	2	3	3	3	3	2	2	1	2	3	2	3	1	3
8	8	2	5	2	1	3	M	M	2	3	3	4	3	M	M	M	5	4	5	5	5	3	4	5	5	4	5	3	4	1	4
9	9	2	2	2	2	M	M	M	1	3	2	3	1	M	M	M	4	3	2	2	3	3	2	1	1	1	2	2	2	2	2
10	10	4	3	2	1	M	M	M	3	4	5	4	M	M	M	M	3	3	3	4	2	1	5	1	1	5	2	1	1	1	5
11	11	4	2	2	1	M	M	M	3	4	1	2	3	M	M	M	5	3	2	2	4	2	2	2	2	2	2	2	4	2	2
12	12	4	2	2	1	3	M	M	3	4	3	3	2	3	4	M	3	3	5	4	3	3	1	2	2	1	5	1	2	3	1
13	13	4	1	2	1	3	M	M	2	3	5	2	3	M	M	M	2	2	4	4	4	4	2	3	3	2	4	4	4	3	2
14	14	4	1	2	4	M	M	M	3	4	5	3	3	[illegible]	M	M	2	2	4	4	4	4	3	3	4	2	3	2	2	2	2
15	15	2	5	1	1	M	M	M	2	3	5	3	3	[illegible]	M	M	2	3	1	2	2	1	1	1	2	1	1	1	2	1	1
16	16	2	3	2	1	3	M	M	2	4	1	5	4	M	M	M	2	1	2	2	2	3	2	1	1	3	1	1	4	1	2
17	17	2	2	2	1	3	M	M	2	4	4	4	4	M	M	M	4	3	3	2	5	1	3	1	1	2	3	1	5	2	3
18	18	4	1	2	1	3	M	M	3	3	4	2	1	M	M	M	4	4	4	4	4	2	4	1	4	2	3	2	3	2	3
19	19	2	2	2	1	M	M	M	1	2	5	3	3	M	M	M	5	3	3	3	3	2	3	1	3	2	4	1	2	1	4
20	20	4	3	2	2	3	M	M	3	4	3	3	M	M	M	M	3	4	5	5	4	M	2	3	3	1	5	4	3	3	1
21	21	2	2	2	3	M	M	M	2	2	4	4	1	M	M	M	3	2	3	3	4	2	4	2	3	3	3	2	3	2	3
22	22	4	2	2	2	3	M	M	2	4	3	2	3	M	M	M	5	3	4	4	2	2	3	1	1	3	3	1	1	1	3

OBS	Q25	Q26	Q27	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	Q46	Q47	Q48	Q49	Q50	Q51	Q52	Q53	Q54	Q55
1	2	3	3	1	3	1	3	3	3	3	4	2	3	1	2	3	2	2	4	5	4	4	3	2	3	1	2	4	2	3	4
2	4	5	4	5	5	5	4	3	2	2	M	1	2	1	1	4	3	3	2	2	1	1	M	M	M	4	2	3	M	M	4
3	1	1	1	1	1	1	1	3	3	2	2	2	1	1	1	1	1	2	3	3	2	2	1	1	1	1	1	3	1	1	1
4	5	3	2	4	2	5	3	3	3	2	3	2	3	2	2	3	2	3	2	2	3	2	2	2	2	2	1	4	3	2	2
5	3	5	3	5	5	5	3	3	1	2	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	3	3	1
6	3	5	3	5	2	4	3	3	2	2	2	2	1	1	1	1	1	2	1	1	2	3	3	3	3	3	3	3	3	3	2
7	3	4	3	3	4	4	2	2	1	3	1	3	1	1	3	1	2	2	1	2	1	2	1	1	1	1	1	2	2	3	1
8	4	5	4	4	1	4	4	4	1	3	1	3	5	2	3	1	2	4	3	3	2	3	5	3	3	1	4	5	2	2	1
9	3	2	1	1	1	1	2	3	2	3	5	2	4	2	4	5	2	3	1	1	5	1	1	1	1	1	1	3	1	1	1

O	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
B	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5
S	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
10	1	4	1	4	2	1	1	2	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	1	1	1
11	3	2	2	3	1	2	2	4	3	3	2	3	2	1	1	1	1	3	3	3	2	2	1	1	1	1	1	3	1	1	1
12	3	3	1	3	3	3	4	3	3	4	2	3	4	2	3	2	2	4	4	5	4	4	4	3	4	3	3	4	4	4	4
13	4	4	4	4	3	2	4	3	2	2	5	2	3	2	2	5	2	4	3	3	5	3	3	2	2	2	2	4	2	2	4
14	3	4	3	4	1	2	2	2	1	3	2	3	1	1	3	3	3	2	2	3	2	2	1	1	1	1	1	2	2	3	2
15	1	2	2	2	1	1	1	2	1	2	2	2	2	1	1	2	1	2	2	2	2	1	1	1	1	1	1	2	1	2	2
16	1	2	1	2	2	3	1	1	1	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	1
17	2	2	3	3	3	1	1	2	1	4	4	2	1	1	1	1	1	2	1	3	2	2	1	1	1	1	1	2	1	4	3
18	4	2	4	4	4	4	4	3	3	3	3	3	3	2	3	3	3	3	2	3	2	3	3	2	2	3	3	4	2	3	3
19	4	4	1	4	2	1	2	2	2	2	1	1	2	2	1	1	1	3	3	4	3	3	1	1	1	1	1	2	1	1	1
20	5	M	2	5	5	4	5	4	4	3	5	5	3	4	3	4	4	2	2	2	4	2	1	1	1	1	1	4	4	3	4
21	3	3	2	3	2	3	3	5	1	2	2	2	2	1	2	2	2	3	2	3	3	3	1	1	1	1	1	3	2	3	2
22	1	2	1	1	2	1	4	4	2	2	3	2	3	2	2	3	2	4	2	2	2	2	3	2	2	2	1	4	2	2	2

O	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
B	5	5	5	5	6	6	6	6	6	6	6	6	6	6	7	7	7	7	7	7	7	7	7	7	8	8
S	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
1	2	4	3	4	3	3	4	5	4	5	5	3	2	2	5	2	3	2	3	5	3	M	M	M	M	M
2	3	3	M	3	5	4	5	4	4	4	4	3	M	4	M	M	M	M	M	M	M	M	M	M	M	M
3	1	1	1	1	1	1	3	3	3	2	3	1	1	1	1	1	M	M	M	M	M	M	M	M	M	M
4	2	3	2	2	2	2	5	2	2	2	2	4	2	2	2	2	M	M	M	M	M	M	M	M	M	M
5	3	5	2	3	1	2	5	3	3	1	2	3	2	3	1	1	M	M	M	M	M	M	M	M	M	M
6	2	4	4	4	2	4	4	5	5	5	4	4	2	3	2	2	M	M	M	M	M	M	M	M	M	M
7	2	1	1	1	1	1	3	4	4	2	3	2	1	3	2	3	M	M	M	M	M	M	M	M	M	M
8	2	4	4	4	1	4	5	5	5	5	5	5	4	5	3	5	M	M	M	M	M	M	M	M	M	M
9	1	3	2	3	3	3	4	3	4	4	4	4	2	3	2	1	M	M	M	M	M	M	M	M	M	M
10	1	1	1	1	1	1	3	3	3	2	3	2	1	1	1	1	M	M	M	M	M	M	M	M	M	M
11	1	3	2	2	2	2	3	2	2	2	2	3	1	1	1	1	M	M	M	M	M	M	M	M	M	M
12	4	3	3	4	2	3	4	4	4	4	3	4	3	4	3	3	M	M	M	M	M	M	M	M	M	M
13	2	4	3	3	5	3	4	2	2	4	2	4	3	3	5	3	M	M	M	M	M	M	M	M	M	M
14	2	1	2	2	2	2	4	4	5	5	5	3	3	4	4	4	M	M	M	M	M	M	M	M	M	M
15	2	2	1	1	1	1	2	2	3	3	3	1	1	1	1	1	M	M	M	M	M	M	M	M	M	M
16	2	2	1	1	1	1	2	2	1	1	1	2	1	1	1	1	M	M	M	M	M	M	M	M	M	M
17	3	1	1	1	1	1	3	1	1	3	1	1	1	1	1	1	M	M	M	M	M	M	M	M	M	M
18	3	4	4	4	[illegible]	4	4	4	4	4	4	4	3	3	3	4	M	M	M	M	M	M	M	M	M	M
19	1	3	2	2	[illegible]	1	4	4	4	4	4	3	3	3	2	1	M	M	M	M	M	M	M	M	M	M
20	3	4	3	3	4	3	4	4	4	4	4	4	4	4	4	4	M	M	M	M	M	M	M	M	M	M
21	3	2	2	3	1	3	3	3	3	4	3	2	2	2	2	2	M	M	M	M	M	M	M	M	M	M
22	2	4	2	2	2	2	4	3	3	3	2	4	4	4	4	4	M	M	M	M	M	M	M	M	M	M

ID	Written Responses
1.	5. Hybrid SPO, Staffing Function, Product Division, Strategic Planning Division
	6. Division Chief, Several small studies
	72. Lotus 1-2-3, Engineering Analysis, spreadsheets, database programming
3.	5. 2816 in 4950TW
	6. Division chief, Flt Test Engineering
4.	6. Director, Acquisition Support
10.	1. Foreign Technology Division
	5. Directorate of Intelligence
	6. Director of Intelligence
	9. N/A - support all ASD regardless of phase
11.	1. Test Center
	5. Test Center
	6. Flight Test Engineer
12.	1. HQ SAC/XPPM Program Management & Analysis Division
	5. PPBS analysis & SAC board Structure
	6. Board structure panel chairman & analyst
13.	1. Ballistic Missile Office
14.	1. Armament Division
	4. Education
	5. HQ AWS
	6. HQ AWS Acquisition Project Officer
16.	6. Deputy director for configuation management
17.	6. Deputy Chief Flight System Engineering Division
18.	1. FTD
	5. Intelligence
20.	1. HQ USAF
	5. N/A
	6. PEM
22.	1. Ballistic Missile Division
	6. Division Chief in Program Control

Raw Survey Data - SYS-400 89B - Control Group
M is the symbol for Missing data - No Answer
Q4II to Q4IV are the multiple answers, if any, to Q4
Q9II to Q9IV are the multiple answers, if any, to Q9

OBS	ID	Q1	Q2	Q3	Q4	Q4II	Q4III	Q4IV	Q5	Q6	Q7	Q8	Q9	Q9II	Q9III	Q9IV	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
1	1	2	2	2	1	M	M	M	2	4	1	2	3	M	M	M	3	4	1	1	3	2	4	1	1	2	2	1	4	1	1
2	2	4	3	2	1	M	M	M	3	4	5	4	3	M	M	M	4	2	4	2	1	2	2	1	1	1	2	1	2	1	1
3	3	2	3	2	1	M	M	M	2	2	3	3	2	M	M	M	2	2	3	5	3	1	5	1	2	4	3	1	1	3	5
4	4	2	2	2	3	M	M	M	2	4	4	2	3	M	M	M	2	2	3	3	2	3	4	2	2	2	3	2	4	2	2
5	5	4	1	1	1	M	M	M	3	4	4	1	4	M	M	M	2	4	4	4	4	3	2	2	4	2	4	2	4	2	4
6	6	4	2	2	1	2	3	M	2	2	4	2	4	M	M	M	4	2	4	4	4	4	4	1	1	1	3	2	5	1	3
7	7	2	3	2	2	3	M	M	3	4	3	3	1	2	3	4	5	5	4	4	4	3	4	2	3	4	2	1	4	4	4
8	8	2	3	2	2	M	M	M	1	4	3	4	1	2	3	4	1	1	4	4	4	4	4	2	3	5	5	1	4	2	4
9	9	2	3	2	3	M	M	M	2	4	2	4	3	M	M	M	3	2	5	4	1	1	1	1	4	2	5	1	4	1	2
10	10	2	3	2	3	M	M	M	1	2	1	3	4	M	M	M	3	2	4	5	4	3	5	1	2	2	3	2	5	2	5
11	11	2	2	2	2	3	M	M	2	3	3	3	3	M	M	M	4	4	3	3	1	1	2	1	3	2	2	1	2	1	3
12	12	2	1	2	3	M	M	M	2	2	5	2	4	M	M	M	5	4	3	4	4	3	3	4	5	2	3	3	4	3	2
13	13	4	4	1	3	M	M	M	3	4	5	5	1	2	3	4	4	3	4	4	4	4	4	4	4	1	4	3	3	3	1
14	14	2	3	3	2	M	M	M	3	4	4	4	2	3	M	M	3	3	4	4	3	2	4	2	2	2	3	2	3	3	2
15	15	4	3	2	2	M	M	M	2	4	4	3	3	M	M	M	5	5	4	4	4	4	5	5	3	3	3	4	4	4	4
16	16	2	3	2	1	3	M	M	1	4	3	4	4	M	M	M	3	3	3	4	2	2	3	2	3	2	1	1	3	1	4
17	17	4	2	2	1	3	M	M	1	2	4	3	2	M	M	M	3	3	3	4	2	3	2	2	3	2	4	2	2	2	4
18	18	2	5	1	1	M	M	M	3	4	4	5	1	2	3	M	3	3	3	4	5	3	5	3	3	5	4	2	3	2	5
19	19	4	1	2	3	M	M	M	3	4	4	3	3	M	M	M	5	5	3	4	4	3	2	2	3	2	5	3	1	3	3

OBS	Q25	Q26	Q27	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	Q46	Q47	Q48	Q49	Q50	Q51	Q52	Q53	Q54	Q55
1	3	2	1	2	2	2	2	2	2	3	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	3	1	1	1
2	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	1	2	2	2	3	3	1	1	1	1	1	2	2	1	1
3	4	1	2	2	3	1	2	3	2	2	2	2	1	1	1	1	1	4	4	4	5	5	1	1	1	1	1	4	1	1	3
4	2	3	4	2	2	2	2	3	2	3	2	3	2	2	2	2	2	4	3	4	3	4	4	1	1	1	2	4	2	2	3
5	3	4	3	4	3	3	3	2	1	2	1	2	2	1	3	1	3	1	1	4	1	3	1	1	4	1	4	1	1	4	1
6	3	3	1	1	3	3	4	3	1	3	3	3	2	1	2	2	4	4	2	4	2	3	2	1	3	1	1	2	4	4	4
7	2	3	4	3	3	2	1	3	1	3	1	3	3	1	4	1	4	4	1	2	1	2	2	1	2	1	2	3	1	2	1
8	2	4	3	2	2	1	1	1	1	1	2	2	1	1	1	1	1	1	1	1	1	2	1	1	1	1	1	2	1	2	2
9	1	1	1	1	1	1	5	3	2	3	4	2	1	1	1	1	1	2	2	2	2	2	1	1	1	1	1	3	4	4	4
10	3	5	3	5	4	2	3	2	1	3	1	3	1	1	3	1	3	1	1	3	2	3	1	1	3	2	2	2	1	4	2
11	1	1	1	1	1	1	1	2	1	1	1	1	2	1	1	1	1	2	1	1	2	1	2	1	1	1	1	2	1	1	1
12	2	4	3	3	2	3	4	2	1	2	2	2	2	2	2	2	2	2	1	1	1	1	2	1	1	1	1	4	4	4	2

O	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
B	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5
S	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
13	2	4	3	3	1	1	3	2	1	1	3	3	1	1	1	1	1	4	4	4	4	4	1	1	1	1	1	2	2	2	2
14	3	4	4	3	3	3	3	3	3	4	4	3	2	2	3	2	3	2	2	3	2	3	2	1	1	2	2	3	3	4	3
15	4	4	3	3	3	3	3	2	2	3	2	2	2	2	3	2	2	3	2	3	1	3	1	1	3	1	3	4	2	2	4
16	2	3	1	2	2	3	3	3	2	3	1	3	3	2	3	1	3	2	2	2	1	2	2	2	2	1	2	3	3	3	1
17	3	4	2	4	4	3	4	3	3	3	2	2	2	1	1	1	1	3	1	2	1	2	1	1	1	1	2	3	3	3	2
18	4	5	2	3	4	3	3	3	1	2	4	1	1	1	1	5	1	3	1	3	5	1	1	1	1	1	1	3	2	2	5
19	3	3	2	3	2	1	2	3	3	2	3	3	4	3	3	3	3	3	2	2	2	2	4	3	3	3	3	4	3	3	3

O	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
B	5	5	5	5	6	6	6	6	6	6	6	6	6	6	7	7	7	7	7	7	7	7	7	7	8	8
S	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
1	1	2	1	1	1	1	3	1	1	1	1	3	1	1	1	1	M	M	M	M	M	M	M	M	M	M
2	1	3	3	3	3	3	2	2	2	2	2	M	M	M	M	M	M	M	M	M	M	M	M	M	M	M
3	1	1	1	1	1	1	4	4	4	4	4	2	2	2	2	2	M	M	M	M	M	M	M	M	M	M
4	3	5	4	3	3	4	5	4	4	4	4	3	3	3	3	3	M	M	M	M	M	M	M	M	M	M
5	4	1	1	4	1	4	3	1	3	1	3	3	1	4	1	3	M	M	M	M	M	M	M	M	M	M
6	4	1	4	4	1	4	5	4	4	4	4	4	4	4	5	4	5	5	4	2	4	M	M	M	M	M
7	2	5	2	3	3	2	4	3	4	5	4	3	1	3	1	3	M	M	M	M	M	M	M	M	M	M
8	2	2	2	2	2	2	2	2	2	2	2	1	1	1	1	1	M	M	M	M	M	M	M	M	M	M
9	3	2	2	2	2	2	4	5	4	5	4	3	5	5	5	5	M	M	M	M	M	M	M	M	M	M
10	3	1	1	2	1	2	4	4	5	3	3	2	2	2	2	2	M	M	M	M	M	M	M	M	M	M
11	1	2	1	2	1	2	4	3	5	4	4	3	3	3	4	3	4	4	4	4	4	M	M	M	M	M
12	3	3	2	3	1	1	4	4	4	4	4	3	3	3	2	3	M	M	M	M	M	M	M	M	M	M
13	2	1	1	1	1	1	3	3	3	2	3	1	1	1	1	1	M	M	M	M	M	M	M	M	M	M
14	3	3	4	4	3	4	4	4	4	4	4	3	3	2	2	3	M	M	M	M	M	M	M	M	M	M
15	2	3	3	3	4	3	4	3	3	4	3	2	2	2	2	2	M	M	M	M	M	M	M	M	M	M
16	3	2	2	2	1	2	3	3	3	2	3	3	3	3	2	3	M	M	M	M	M	M	M	M	M	M
17	1	3	3	3	3	3	4	4	4	4	4	4	4	4	4	2	M	M	M	M	M	M	M	M	M	M
18	1	3	1	2	5	1	3	1	2	5	1	3	1	1	4	1	M	M	M	M	M	M	M	M	M	M
19	3	3	3	3	3	3	4	3	3	3	3	3	3	3	3	3	M	M	M	M	M	M	M	M	M	M

ID Written Responses

1. 6. Engineer
2. 1. A Test Center
   5. Test Center
   6. Technology Director
4. 6. Test Manager
5. 1. HQ AFCC
   5. MAJCOM HQ
   6. SYSTO
6. 1. Ballistic Systems Division
   72. Exception Reporting
7. 5. 4950 Test Wing
   6. Division Chief, Communications & Computers
8. 6. Deputy Director
9. 6. Program Control
11. 72. Database applications: trends, item tracking, historical data, status of accomplishments
12. 4. Public Administration
13. 1. HQ MAC/XPQS
    5. Operational Requirements Director
    6. Program monitor for using command, interface with single progam manager
14. 5. Test Wing
    6. Program Manager Supervisor
15. 1. HQ SAC/XR
    6. User SYSTO
16. 6. Deputy Program Manager
17. 1. AFTAC
18. 5. 4950 Test Wing
    6. Branch Chief

Raw Survey Data - SYS-400 89C - Treatment Group
M is the symbol for Missing data - No Answer
Q4II to Q4IV are the multiple answers, if any, to Q4
Q9II to Q9IV are the multiple answers, if any, to Q9

OBS	ID	Q1	Q2	Q3	Q4	Q4II	Q4III	Q4IV	Q5	Q6	Q7	Q8	Q9	Q9II	Q9III	Q9IV	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
1	1	2	2	1	1	M	M	M	2	2	4	4	3	M	M	M	3	4	4	4	3	3	3	2	1	2	1	1	4	2	2
2	2	4	3	2	1	3	M	M	1	4	2	4	1	2	3	M	3	3	3	4	4	4	5	3	3	4	4	4	4	3	3
3	3	4	1	2	2	3	M	M	3	3	1	2	2	3	M	M	3	3	2	1	2	1	3	1	1	2	2	1	1	1	1
4	4	2	1	2	2	M	M	M	2	3	5	3	3	M	M	M	3	2	3	3	3	3	1	1	3	1	2	2	3	2	1
5	5	4	5	2	3	M	M	M	3	4	5	5	3	M	M	M	3	2	1	1	1	3	3	3	1	2	3	3	1	3	3
6	6	2	3	2	1	M	M	M	2	2	4	3	4	M	M	M	3	3	3	3	2	4	2	4	4	2	2	4	3	2	4
7	7	2	2	2	2	3	M	M	1	2	3	2	2	M	M	M	3	3	4	5	4	4	2	3	4	2	2	3	4	2	1
8	8	2	1	2	1	3	M	M	1	2	5	2	3	M	M	M	2	2	5	4	4	3	3	2	3	3	2	3	3	3	3
9	9	4	3	2	1	M	M	M	1	3	2	3	2	M	M	M	3	4	4	4	4	3	4	1	4	4	4	2	3	1	4
10	10	2	2	2	3	M	M	M	2	4	4	2	2	M	M	M	3	4	5	4	1	1	3	1	1	2	5	1	1	1	1
11	11	2	5	1	3	4	M	M	3	4	4	4	1	2	3	4	3	3	4	4	4	4	1	3	3	2	3	3	2	3	2
12	12	4	5	3	4	M	M	M	3	4	5	3	M	M	M	M	3	3	2	2	2	3	1	1	3	2	3	2	1	2	1
13	13	2	1	2	2	3	M	M	1	2	4	1	2	M	M	M	4	2	4	4	4	3	2	2	3	1	4	2	4	3	3
14	14	2	4	4	4	M	M	M	2	4	1	3	1	2	3	4	3	2	4	3	1	2	5	2	2	4	2	1	5	2	3
15	15	4	2	2	1	3	M	M	3	2	5	3	2	M	M	M	3	2	5	4	4	3	4	2	3	2	3	2	2	2	4
16	16	2	2	2	1	3	M	M	1	3	3	4	1	2	3	4	2	2	4	4	2	4	3	1	3	2	3	1	1	4	3
17	17	2	2	2	1	M	M	M	3	4	5	2	1	M	M	M	5	4	4	4	4	4	3	3	2	2	3	4	2	3	4
18	18	3	2	2	1	M	M	M	2	2	4	2	4	M	M	M	4	2	3	4	4	3	3	2	4	2	2	3	3	3	4

OBS	Q25	Q26	Q27	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	Q46	Q47	Q48	Q49	Q50	Q51	Q52	Q53	Q54	Q55
1	4	4	3	4	4	3	3	4	2	2	4	2	4	1	2	3	2	2	1	2	2	2	1	1	1	1	1	2	1	2	2
2	3	3	2	3	3	3	3	3	3	4	3	3	4	3	4	4	1	3	3	4	3	3	2	2	2	2	2	3	3	4	3
3	1	1	1	1	1	1	1	1	1	2	2	1	M	M	M	M	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
4	1	2	1	2	2	3	2	4	2	3	2	3	4	2	3	1	3	4	1	2	1	2	3	1	2	1	2	4	2	3	1
5	1	2	1	2	1	1	3	4	3	3	2	3	4	3	2	2	4	4	4	4	4	4	3	3	3	3	3	4	3	3	3
6	3	4	2	3	3	4	4	3	2	2	2	2	3	1	2	1	1	3	1	2	1	1	3	1	1	1	1	3	1	1	1
7	1	4	4	4	3	3	4	3	2	3	2	3	3	2	3	2	3	3	1	2	2	3	2	1	2	2	2	3	2	2	3
8	3	3	3	5	2	3	3	2	1	2	2	2	2	1	2	2	2	1	2	2	2	2	2	2	2	2	2	3	2	2	2
9	4	4	4	4	4	4	4	4	3	4	4	4	4	3	3	3	3	5	5	5	5	5	2	2	2	2	4	3	4	3	3
10	1	3	1	2	1	4	5	4	3	4	4	3	3	3	3	M	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2
11	3	2	3	3	3	3	3	3	2	2	2	2	3	3	2	2	2	3	3	4	4	3	2	1	1	1	1	3	3	3	3
12	1	3	2	2	1	1	2	3	3	3	2	3	2	1	1	1	1	3	2	2	1	2	2	1	1	1	1	3	2	2	2
13	3	3	3	3	4	3	4	3	1	2	5	2	3	1	2	4	2	5	2	2	4	2	3	2	3	4	2	4	2	2	5

O	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
B	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	5	5	5	5	5	5
S	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5
14	1	3	3	2	4	2	2	3	3	3	5	3	1	1	2	2	2	2	2	2	2	2	1	1	1	1	1	2	2	3	2
15	3	3	2	4	4	4	4	5	3	4	2	4	3	2	3	1	4	4	1	3	2	2	3	1	2	3	2	4	4	5	1
16	2	3	3	3	1	2	4	2	2	3	5	2	2	1	2	4	1	3	1	2	4	1	2	1	1	4	1	2	1	1	4
17	3	4	2	4	3	2	2	4	3	4	2	3	3	2	3	2	3	4	2	2	2	2	2	1	2	2	3	4	2	3	2
18	3	3	2	3	3	2	2	3	2	2	1	2	2	1	2	1	2	4	2	2	1	2	2	1	1	1	1	3	2	2	2

O	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
B	5	5	5	5	6	6	6	6	6	6	6	6	6	6	7	7	7	7	7	7	7	7	7	7	8	8
S	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1
1	2	2	2	2	2	2	3	2	3	3	3	3	3	3	4	4	M	M	M	M	M	M	M	M	M	M
2	4	3	4	4	3	3	4	4	4	4	4	4	4	4	4	4	M	M	M	M	M	M	M	M	M	M
3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	M	M	M	M	M	M	M	M	M	M
4	3	2	1	2	1	2	5	4	4	4	4	4	3	3	1	3	M	M	M	M	M	M	M	M	M	M
5	3	3	2	2	2	2	4	4	4	4	4	4	4	4	4	4	M	M	M	M	M	M	M	M	M	M
6	1	3	1	1	1	1	3	1	1	1	1	3	1	1	1	1	M	M	M	M	M	M	M	M	M	M
7	2	2	3	3	2	3	4	4	3	4	4	3	2	2	3	3	M	M	M	M	M	M	M	M	M	M
8	2	2	2	2	2	2	3	2	2	2	2	2	2	2	2	M	M	M	M	M	M	M	M	M	M	M
9	3	5	4	4	4	4	4	3	3	2	3	4	4	4	4	4	M	M	M	M	M	M	M	M	M	M
10	2	3	3	3	3	3	3	3	3	3	3	5	5	5	5	5	M	M	M	M	M	M	M	M	M	M
11	3	4	4	5	4	4	4	4	4	4	3	4	3	3	4	4	M	M	M	M	M	M	M	M	M	M
12	2	3	2	2	2	2	4	3	3	2	3	3	2	2	2	2	M	M	M	M	M	M	M	M	M	M
13	2	3	2	3	5	2	4	4	4	5	3	4	3	3	5	3	M	M	M	M	M	M	M	M	M	M
14	2	2	M	4	2	3	3	3	3	4	2	2	2	3	2	2	M	M	M	M	M	M	M	M	M	M
15	5	4	4	4	1	4	3	2	4	1	4	5	5	5	2	4	M	M	M	M	M	M	M	M	M	M
16	1	3	2	3	4	2	2	2	2	3	2	4	4	5	4	4	M	M	M	M	M	M	M	M	M	M
17	3	3	2	3	2	3	5	3	3	3	3	4	4	4	4	4	M	M	M	M	M	M	M	M	M	M
18	2	2	1	2	1	1	3	2	3	2	2	3	2	3	2	2	M	M	M	M	M	M	M	M	M	M

ID	Written Responses
2.	1. Standard System Center
	6. Program Support on matrix basis
3.	1. AFOTEC
	5. Test Organization
5.	1. MSD
	5. Engine/ATF
11.	4. Logistics Management
	5. Logistics Staff
	6. S.E. Acquistion Manager
12.	1. HQ AFSC
	4. English and History
	5. HQ Organization
	6. ILS Manager
	9. N/A - I don't have a program
15.	1. Human Systems Division
	5. ADPO (Advanced Development Program Office)
	6. ADPO Director
17.	5. Staff Office
	6. Program Director for Avionics Standardization

Raw Survey Data - SYS-400 89D - Treatment Group
M is the symbol for Missing data - No Answer
Q4II to Q4IV are the multiple answers, if any, to Q4
Q9II to Q9IV are the multiple answers, if any, to Q9

OBS	ID	Q1	Q2	Q3	Q4	Q4II	Q4III	Q4IV	Q5	Q6	Q7	Q8	Q9	Q9II	Q9III	Q9IV	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20	Q21	Q22	Q23	Q24
1	1	2	2	2	3	M	M	M	3	4	5	2	1	M	M	M	3	3	5	2	1	3	4	2	2	3	5	2	3	2	4
2	2	2	2	2	1	M	M	M	2	4	3	2	3	M	M	M	3	3	4	4	4	3	2	2	3	2	2	1	4	3	3
3	3	2	1	2	3	M	M	M	2	2	5	3	3	4	M	M	3	4	4	4	3	5	3	2	4	3	4	3	4	3	3
4	4	4	1	1	3	M	M	M	3	4	5	2	1	3	4	M	4	5	4	3	3	2	2	2	2	2	4	2	2	2	3
5	5	2	2	2	1	3	M	M	2	2	3	2	3	M	M	M	3	3	4	4	4	3	4	2	4	4	5	2	5	2	5
6	6	4	2	1	1	M	M	M	3	4	4	3	5	M	M	M	4	3	2	3	4	2	1	1	2	1	2	1	2	4	2
7	7	2	5	1	1	M	M	M	1	2	5	3	2	3	4	M	3	2	3	3	3	3	2	2	3	2	3	2	3	2	2
8	8	2	2	1	2	M	M	M	1	4	1	2	2	3	4	M	3	3	2	3	3	1	1	1	2	1	1	1	3	1	1
9	9	2	3	2	1	3	M	M	1	2	3	4	4	M	M	M	4	1	5	5	5	5	5	2	3	2	2	2	5	2	4
10	10	4	5	2	2	3	M	M	3	4	5	5	5	M	M	M	5	3	3	3	3	3	4	3	3	3	3	2	3	3	4
11	11	4	2	2	1	2	3	M	3	4	3	3	1	2	M	M	5	5	4	4	4	3	4	1	4	1	2	1	1	1	1
12	12	2	5	2	1	M	M	M	1	4	5	3	3	M	M	M	1	1	4	4	3	2	2	1	2	2	2	1	3	2	2
13	13	4	2	2	1	3	M	M	3	2	4	3	1	3	4	M	4	3	4	4	3	3	2	2	4	1	4	2	3	2	2
14	14	4	2	2	3	M	M	M	2	4	3	2	4	M	M	M	4	5	3	4	2	2	4	2	3	4	4	3	4	2	4
15	15	2	2	2	3	4	M	M	2	2	2	2	3	M	M	M	3	3	4	4	4	4	2	3	4	2	3	4	4	4	3
16	16	4	1	2	3	M	M	M	2	3	5	2	1	2	3	4	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5
17	17	2	1	2	1	3	M	M	2	3	4	2	2	M	M	M	5	5	3	3	3	3	1	4	3	1	1	4	4	2	1

OBS	Q25	Q26	Q27	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	Q46	Q47	Q48	Q49	Q50	Q51	Q52	Q53	Q54	Q55
1	1	1	2	1	2	5	5	5	4	4	4	4	5	3	3	2	3	5	2	2	2	2	5	3	3	2	3	5	2	2	1
2	4	3	2	4	3	2	3	3	2	3	2	2	1	1	1	1	1	3	1	2	2	2	1	1	1	1	1	3	2	3	2
3	2	4	4	4	3	4	4	3	2	3	2	3	2	2	2	2	2	3	2	3	2	3	2	1	2	1	3	3	3	3	2
4	2	3	2	4	3	3	4	5	3	3	2	3	5	3	3	2	2	5	2	2	2	2	2	1	1	1	1	4	2	2	1
5	3	4	4	5	4	5	2	1	1	3	1	1	1	1	3	1	1	1	1	3	1	1	2	1	2	1	1	3	1	3	2
6	4	2	2	1	4	3	2	3	2	2	5	3	3	1	2	3	2	3	2	2	5	3	2	1	2	3	2	2	2	3	3
7	2	3	4	3	3	2	3	2	1	2	1	2	2	1	2	1	1	2	2	3	2	2	2	1	2	1	2	2	2	3	2
8	4	1	2	3	1	2	1	2	2	2	2	2	3	2	1	1	2	3	2	2	1	2	3	1	1	1	1	3	1	1	1
9	3	4	4	5	4	2	2	5	4	4	2	3	4	2	2	1	2	4	4	4	1	3	3	1	1	1	1	4	2	3	1
10	3	3	3	3	3	3	3	4	2	3	4	2	4	2	3	4	2	4	2	3	4	2	3	2	3	2	2	4	4	4	3
11	4	2	4	4	4	4	4	5	4	4	5	4	5	3	3	5	3	5	5	5	5	5	5	5	5	5	5	5	4	3	5
12	3	5	4	4	3	2	2	3	2	2	2	2	2	1	1	1	1	3	2	2	2	2	1	1	1	1	1	3	2	2	2
13	4	3	2	3	3	2	2	3	2	2	2	2	2	1	1	1	2	2	1	1	1	1	1	1	1	1	1	3	3	3	3
14	4	4	4	4	3	3	4	4	3	3	5	3	1	1	M	M	M	2	1	3	M	3	1	1	3	2	3	3	3	1	1

OBS	Q25	Q26	Q27	Q28	Q29	Q30	Q31	Q32	Q33	Q34	Q35	Q36	Q37	Q38	Q39	Q40	Q41	Q42	Q43	Q44	Q45	Q46	Q47	Q48	Q49	Q50	Q51	Q52	Q53	Q54	Q55
15	3	4	2	5	4	4	4	2	1	1	2	2	1	1	1	1	1	2	1	2	2	2	2	2	2	2	2	3	2	2	2
16	5	5	5	5	5	5	5	3	2	1	5	3	3	2	1	5	3	3	2	1	5	3	3	1	1	1	1	5	1	1	4
17	3	4	3	5	5	4	2	5	1	3	4	4	3	1	1	1	1	5	1	1	1	1	1	1	1	1	1	3	1	1	1

OBS	Q56	Q57	Q58	Q59	Q60	Q61	Q62	Q63	Q64	Q65	Q66	Q67	Q68	Q69	Q70	Q71	Q72	Q73	Q74	Q75	Q76	Q77	Q78	Q79	Q80	Q81
1	2	4	2	1	1	4	5	3	3	1	2	5	5	5	5	5	M	M	M	M	M	M	M	M	M	M
2	3	4	4	3	3	3	4	3	3	4	3	3	2	2	2	2	M	M	M	M	M	M	M	M	M	M
3	3	4	4	4	4	4	4	4	4	4	4	4	3	3	3	3	M	M	M	M	M	M	M	M	M	M
4	1	3	2	3	1	1	5	2	3	2	1	5	4	4	3	3	M	M	M	M	M	M	M	M	M	M
5	2	2	2	2	1	2	3	2	2	2	2	4	3	4	4	4	M	M	M	M	M	M	M	M	M	M
6	2	3	2	3	2	3	4	3	3	4	3	3	3	4	4	3	M	M	M	M	M	M	M	M	M	M
7	2	3	4	3	2	2	3	3	3	3	3	3	4	4	4	4	M	M	M	M	M	M	M	M	M	M
8	1	3	1	1	1	1	4	3	3	3	2	2	1	1	1	1	M	M	M	M	M	M	M	M	M	M
9	2	3	2	2	1	2	5	4	4	4	4	5	[illegible]	3	2	2	M	M	M	M	M	M	M	M	M	M
10	4	3	3	4	4	4	5	4	4	4	4	5	3	4	4	4	3	3	4	3	3	3	3	4	3	3
11	3	5	4	3	5	4	5	5	5	5	5	5	4	4	5	4	M	M	M	M	M	M	M	M	M	M
12	2	3	3	3	2	2	4	3	3	2	3	2	2	2	2	2	M	M	M	M	M	M	M	M	M	M
13	2	3	1	2	1	2	4	2	2	2	2	2	2	2	2	2	M	M	M	M	M	M	M	M	M	M
14	4	1	1	M	M	M	4	4	4	5	4	5	4	4	5	5	M	M	M	M	M	M	M	M	M	M
15	2	3	2	2	2	2	2	2	2	2	2	2	2	2	2	2	M	M	M	M	M	M	M	M	M	M
16	1	4	3	4	5	5	5	5	3	3	5	3	5	5	5	3	M	M	M	M	M	M	M	M	M	M
17	1	1	1	1	1	1	5	5	5	5	5	5	[illegible]	5	5	5	M	M	M	M	M	M	M	M	M	M

ID	Written Responses
1.	5. Laboratory
	6. Dep. Director Program Control
2.	6. Lead Systems Engineer
4.	1. HQ AFCC Scott AFB, IL
	5. HQAFCC, Scott AFB, IL
	6. SYSTO/Action Officer
6.	1. HQ AFSC
	5. Not presently in SPO
	6. Inspector
	9. Not Applicable
8.	6. Division Chief, Manufacturing/QA
10.	1. AFFTC
	5. Range I&M Development
	6. Branch Chief
	9. All of above
	72. Cost construction models for software development cost estimation.
	77. Risk Assesment Models for Software Development
11.	1. Human System Division
	5. Laboratory
	6. Project Research Engineer/Scientific Analyst
12.	6. Flight Test Manager
13.	1. MAC
	5. MAC HQ - Basket Div
14.	1. BSD
	6. Program Control Analyst
15.	4. Political Science

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The main focus of this thesis was to determine if exposing an Air Force system acquisition midlevel program manager to a computer aided quantitative decision support technique in an academic environment, affected the frequency that the manager used quantitative decision support techniques in actual program and project problems.

A quantitative decision support technique, decision tree analysis, was taught in the Intermediate Program Management (SYS-400) Professional Continuing Education (PCE) course at Wright-Patterson AFB, OH. Before this research began, the classes were doing the decision tree calculations without the aid of a computer. This study focused on whether modifying the curriculum to teach the use of PC based decision support system (DSS) decision tree computations to program managers would affect the frequency they used quantitative techniques in addressing actual program and project problems. The experiment was a posttest-only quasi-experiment design with nonequivalent groups. This study did not try to discover if other teaching techniques or other situations will alter the frequency of quantitative technique use.

Three months after course completion, an after-course survey was sent to each course graduate. The survey measured the graduate's familiarity and frequency of using several quantitative decision support techniques to measure the effect of the classroom instruction. Demographic and responsibility, information were collected. This information was used to identify possible effects, other than the treatment effect, obscuring the analysis.

This study measured an increase (in the treatment group) of some of the technique familiarity, use, computerization benefit, computer program availability and use opportunity. The majority of program managers are familiar with several quantitative decision support techniques. However, very few managers use those techniques regularly.